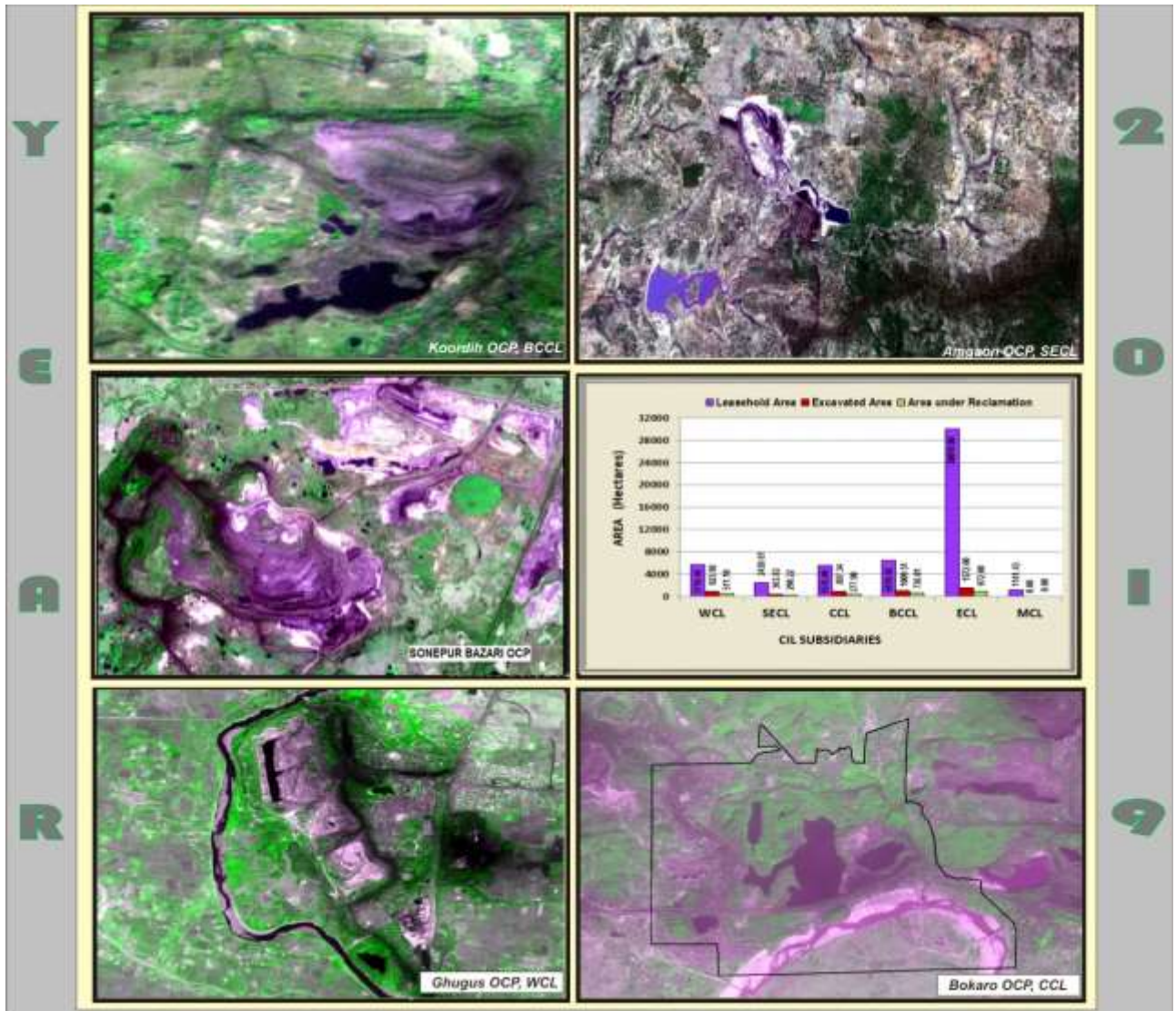


Land Restoration / Reclamation Monitoring of 27 Opencast Projects producing less than 5 mcm (Coal+ OB) per annum & 08 Clusters of Coal Mines based on Satellite Data for the Year 2019



Submitted to
Coal India Limited



cmpdi
A Miniratna Company

**Land Restoration / Reclamation Monitoring of 27 Opencast
Projects producing less than 5 mcm (Coal+ OB) per annum & 08
Clusters of Coal Mines based on Satellite Data for the Year 2019**

MARCH- 2020



**Remote Sensing Cell
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CMPDI, Ranchi**

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Executive Summary

- 1.0 Project** Monitoring of Land restoration / reclamation of 27 opencast projects producing less than 5 mcm (coal +OB) & 08 clusters of coal mines in different subsidiaries of Coal India Ltd (CIL) based on satellite data regularly at an interval of three years.
- 2.0 Objective** Objective of the land restoration / reclamation monitoring is to assess the area of backfilled, plantation, social forestry, active mining area, water bodies, and distribution of wasteland, agricultural land and forest in the leasehold area of the project. This will help in assessing the progressive status of mined land reclamation and to take up remedial measures, if any, required for environmental protection.
- 3.0 Salient Findings** Out of the total mine leasehold area of 51470.58 Hectares of the 27 Opencast projects producing less than 5 mcm (coal +OB) & 08 clusters taken together in different subsidiaries of CIL considered for monitoring during 2019-20; total excavated area is only 4766.66 hectares out of which 661.51 hectares (13.88%) has been planted (*Biologically Reclaimed*), 2225.72 hectares area (46.69%) is under backfilling (*Technically Reclamation*) and balance 1879.43 hectares (39.43%) is under active mining. It is evident from the analysis that 2887.23 hectares (60.57%) area of the 27 OC projects and 08 clusters taken together for study in the year 2019-20 under different subsidiaries of CIL is under reclamation and balance 1879.43 hectares (39.43%) area is under active mining. Company wise details are given in Table-1 & Fig-1.
- The projects selected for land reclamation monitoring in the year 2019-20 are subdivided into two groups viz - Group (A) includes 27 opencast projects belonging to WCL, SECL, CCL & MCL Group (B) includes 08 cluster of mines of BCCL and ECL respectively.
- For Group A, out of total mine leasehold area of 14873.56 hectare of the 27 OC projects considered for land reclamation monitoring during 2019-20: Total excavated area is 2185.15 Hectares out of which 363.73 hectares (16.65%) has been planted (*Biologically Reclaimed*), 815.49 hectares area (37.32%) is under backfilling (Technical Reclamation) and balance 1005.93 hectares (46.03%) is under active mining . It is evident from analysis that 1005.93 hectares (46.03%) area of the 27 OC projects taken for study for the year 2019-20 is under active mining. Subsidiary / Company

wise detail of land reclamation of the above 27 projects is given in Table-1(A) & Fig (1)

- The similar set of mines were monitored in the year 2016-17. On comparing the status of land reclamation monitoring based on satellite data for 27 nos. of opencast projects in WCL, SECL, CCL & MCL carried out in year 2019-20 with respect to previous cycle study done in the year 2016-2017, it is evident from the analysis that area under land reclamation has increased from 831.82 Hectares (45.19%) in Yr. 2016-17 to 1179.22 Hectares (53.97%) in the Yr. 2019-20. This includes both plantation (Biological Reclamation) and areas under backfilling (Technical Reclamation). This increase of 347.40 hectares area of land reclamation in a period of three years is the result of the efforts made by CIL's subsidiary companies towards land reclamation.
- It has been observed that in all opencast project of WCL, SECL, CCL and MCL taken for monitoring of land reclamation in 2019-20: technical and biological reclamation has increased or remained static in the leasehold areas of selected opencast projects in the year 2019-20 as compared to the year 2016-17.
- For Group B, out of the total mine leasehold of 36597.02 Hectare for total 08 cluster of mines; 04 each in BCCL and ECL respectively considered for monitoring during the year 2019-20 consisting of mostly underground and few opencast mines; total excavated area is 2581.51 Hectare ,out of which 297.78 hectare (11.54%) has been planted on backfill (Biologically Reclaimed), 1410.23 Hectare (54.63%) area is under backfilling (Technical Reclamation) and balance 873.50 hectare (33.84%) area is under active mining. It is evident from Table-1(B) that 1708.01 Hectare (66.16%) area is under reclamation and balance 873.50 Hectare (33.84%) area is under active mining.
- It is evident from analysis that for 08 clusters of mines belonging to BCCL and ECL, taken for land reclamation monitoring based on satellite data, total area under plantation (Green cover) is 2026.81 (5.54%) .
- It has also been observed from table - 1(B) that Biological Reclamation for 08 cluster of mines in BCCL and ECL is 297.78 Hectares (11.54%) in the year 2019-20.

- Concept of cluster of mines was not there for land reclamation study done in the year 2016-17. Hence comparison of status of land reclamation for the year 2019-20 with respect to year 2016-17 has not been made.
- From table 1 (A) and 1(B) combined, It can be seen that total area under reclamation in the 27 opencast mines of WCL, SECL, MCL, CCL and 08 clusters of BCCL and ECL is 2887.23 Hectares out of which 661.51 hectares (13.88%) has been planted (Biologically Reclaimed) and 2225.72 hectares area (46.69%) is under backfilling (Technical Reclamation) and 1879.43 Hectares (39.43%) is under active mining.
- It is important to note that a new Table format has been designed by Coal India Ltd. with new parameters for Biological & Technical reclamation. For comparative purpose the basic dataset for the year 2016 -17 has been fed into new format so that it can be compared with the result of 2019-20 as per new format.

TABLE-1
COMPANY WISE LAND RECLAMATION STATUS IN OC PROJECTS AND O8 CLUSTER OF MINES BASED ON SATELLITE DATA OF YEAR 2019
(Projects producing less than 5 million cu.m. Coal +OB)

Sl. No.	Coal Company (No. of OC Projects / Clusters)	Area in Hectare (% calculated in respect of total excavated area)																		
		Leasehold / All Right Boundary		Technical Reclamation		Plantation						Area under Active Mining		Total Excavated Area		Total Area under Plantation (% Green Cover generated in Leasehold)		Total Area under Reclamation		
						Biological		Other Plantation												
				Area under Backfilling / OB		Area under Plantation		Plantation on External OB Dumps		Social Forestry, Avenue Plantation etc.										
1.00	2.00	3.00		4.00		5.00		6.00		7.00		8.00		9 (=4+ 5+ 8)		10 (=5+ 6+ 7)		11 (=4+ 5)		
		2016	2019	2016	2019	2016	2019	2016	2019	2016	2019	2016	2019	2016	2019	2016	2019	2016	2019	
(A)	PROJECTWISE																			
1	WCL (11)	5920.76	5716.46	324.39 47.24	422.14 45.69	56.59 8.24	88.96 9.63	281.28	349.28	174.10	237.62	305.72 44.52	412.88 44.68	686.70	923.98	511.97 8.65	675.86 11.82	380.98 55.48	511.10 55.32	
2	SECL (04)	2439.61	2439.61	135.08 39.14	173.71 47.74	104.24 30.21	116.51 32.02	0.00	1.45	63.20	93.70	105.76 30.65	73.61 20.23	345.08	363.83	167.44 6.86	211.66 8.68	239.32 69.35	290.22 79.77	
3	MCL (01)	-	1141.43	-	0.00 0.00	-	0.00 0.00	-	0.00	-	0.00	0.00 0.00	0.00 0.00	-	0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	
4	CCL (11)	5576.06	5576.06	92.60 11.45	219.64 24.48	118.92 14.70	158.26 17.64	404.22	370.31	284.97	306.77	597.54 73.86	519.44 57.89	809.06	897.34	808.11 14.49	835.34 14.98	211.52 26.14	377.90 42.11	
SUB TOTAL (A) (27)		13936.43	14873.56	552.07 29.99	815.49 37.32	279.75 15.20	363.73 16.65	685.50	721.04	522.27	638.09	1009.02 54.81	1005.93 46.03	1840.84	2185.15	1487.52 10.67	1722.86 11.58	831.82 45.19	1179.22 53.97	
(B)	CLUSTERSWISE																			
5	BCCL (04)	-	6519.02	-	624.23 61.83	-	111.78 11.07	-	62.48	-	306.55	-	273.50 27.09	-	1009.51	-	480.81 7.38	-	736.01 72.91	
6	ECL (04)	-	30078.00	-	786.00 50.00	-	186.00 11.83	-	100.00	-	1260.00	-	600.00 38.17	-	1572.00	-	1546.00 5.14	-	972.00 61.83	
SUB TOTAL (B) (08)		0.00	36597.02	-	1410.23 54.63	-	297.78 11.54	-	162.48	-	1566.55	-	873.50 33.84	-	2581.51	-	2026.81 5.54	-	1708.01 66.16	
TOTAL CIL (A+B) (35)		13936.43	51470.58	552.07 29.99	2225.72 46.69	279.75 15.20	661.51 13.88	685.50	883.52	522.27	2204.64	1009.02 54.81	1879.43 39.43	1840.84	4766.66	1487.52 10.67	3749.67 7.29	831.82 45.19	2887.23 60.57	

Note : Total Excavated Area (%) is calculated in respect to the Leasehold / All Right Boundary .

Note: In reference of the above Table, different parameters are classified as follows:

1. Area under **Biological Reclamation** includes Areas under Plantation done on Backfilled Area Only.
2. Area under **Technical Reclamation** includes Area under Barren Backfilling only
3. Area under Active Mining Includes Coal Quarry, Advance Quarry Site, Quarry filled with water etc., if any.
4. Social Forestry and Plantation on External OB Dumps are not included in Biological Reclamation and are put under separate categories as shown in the Table above.
5. (%) calculated in the above Table is in respect to Total Excavated Area except for "Total Area under Plantation" where % is in terms of "Leasehold Area".

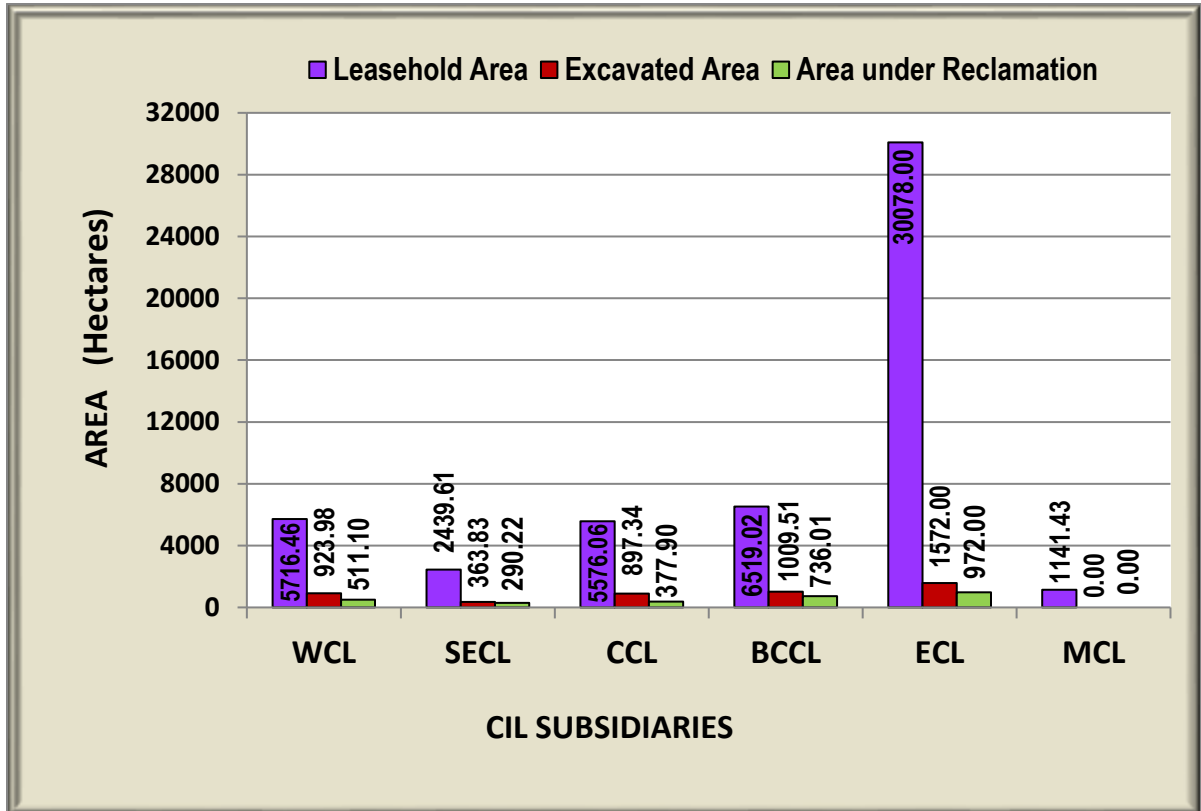


Fig1: Companywise Land Reclamation Status in opencast and cluster of mines the year 2019

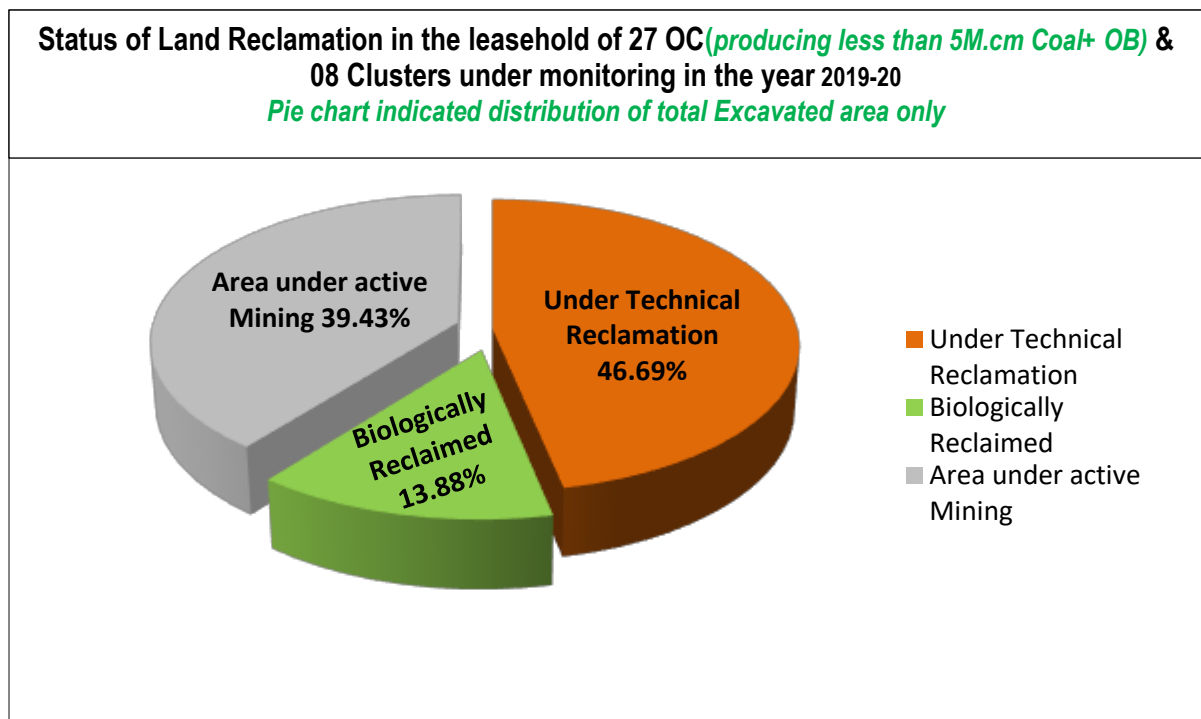


Fig 2. Chart indicating Land Reclamation Status in 2019

Background

- 1.1** Land is the most important natural resource which embodies soil, water, flora, fauna and total ecosystem. All human activities are based on the land which is the scarcest natural resource in our country. Mining is a site specific industry and it could not be shifted anywhere else from the location where mineral occurs. It is a fact that surface mining activities do effect the land environment due to ground breaking. Therefore, there is an urgent need to reclaim and restore the mined out land for its productive use for sustainable development of mining. This will not only mitigate environmental degradation, but would also help in creating a more congenial environment for land acquisition by coal companies in future.
- 1.2** Keeping above in view, a work order vide letter no. CIL/WBP/ENV./2011dated23/08/11 was issued by CIL for monitoring of less than 5 million m³ per annum capacity (Coal +OB) projects from the year 2011 at interval of three years. Further, a revised work order was issued vide letter no. CIL/WBP/Env/2011/4706 dated 12.10.2012 from Coal India Limited for the period 2012-13 to 2016-17 which was subsequently followed by another work order vide letter no. CIL/WBP/Env/2017/DP/8477 dated 21.09.2017 from Coal India Limited for the period 2017-18 to 2021-22 for land reclamation monitoring of opencast projects and vegetation cover monitoring of 19 major coalfields.. According to this work order, all mines in CIL with output capacity of 5 million cu. m (coal +OB) shall be monitored every year and all mines below this capacity shall be monitored at an interval of 3 yrs. All coalfields in CIL shall also be monitored at an interval of 3 years as per a defined plan. The result of land reclamation status of all such mines to be put on the website of CIL, (www.coalindia.in), CMPDI (www.cmpdi.co.in) and the concerned coal companies in public domain. Detail report to be submitted to Coal India Limited and respective subsidiaries.

- 1.3** Land reclamation monitoring of all opencast coal mining projects would also comply the statutory requirements of Ministry of Environment & Forest (MoEF).Such monitoring would not only facilitate in taking timely mitigation measures against environmental degradation, but would also enable coal companies to utilize the reclaimed land for larger socio-economic benefits in a planned way.
- 1.4** CMPDI undertook the above study and the present report is embodying the findings in nutshell carrying out for the 27 opencast projects and 08 clusters of different subsidiaries producing less than 5 million cubic m. coal +OB in the year 2019-20 for baseline data generation / updation of these projects so that progressive changes in the status of land reclamation could be assessed in future.

2.0 Objective

Objective of the land reclamation/restoration monitoring is to assess the area of backfilled, plantation, OB dumps, social forestry, active mining area, settlements and water bodies, distribution of wasteland, agricultural land and forest land in the leasehold area of the project. This is an important step taken up for assessing the progressive status of mined land reclamation and for taking up remedial measures, if any, required for environmental protection.

3.0 Methodology

There are number of steps involved between raw satellite data procurement and preparation of final map. National Remote Sensing Centre (NRSC) Hyderabad, being the nodal agency for satellite data supply in India, provides only raw digital satellite data, which needs further digital image processing for extracting the information and map preparation before uploading the same in the website. Methodology for land reclamation monitoring is given in fig 3. Following steps are involved in land reclamation /restoration monitoring:

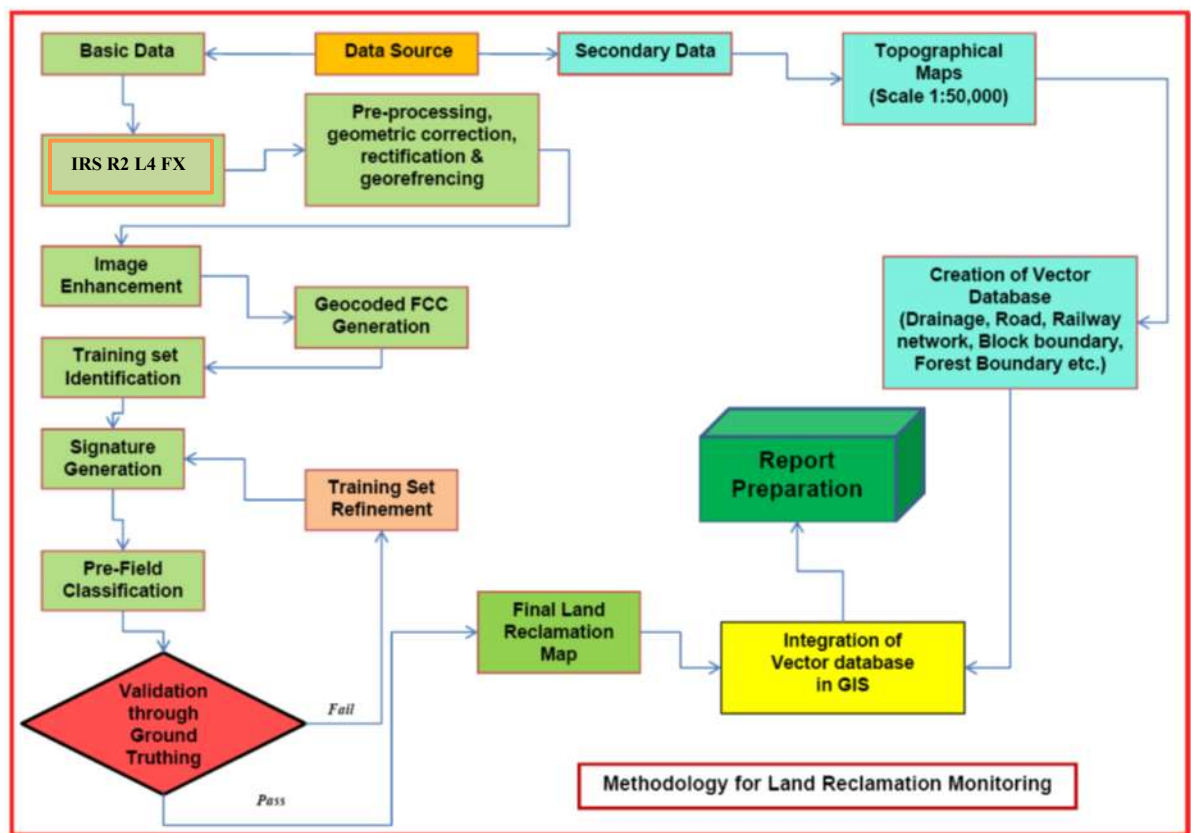


Fig.3: Methodology for land reclamation monitoring

3.1 Data Procurement: After browsing the data quality and date of pass on internet, supply order for data is placed to NRSC. Secondary data like leasehold boundary, topo sheets are procured for creation of vector database.

3.2 Satellite Data Processing: Satellite data are processed using ERDAS IMAGINE v2014 s/w / PCI Geomatica v10.1 s/w digital image processing s/w. Methodology involves the following major steps:

- **Rectification & Georeferencing:** Inaccuracies in digital imagery may occur due to 'systematic errors' attributed to earth curvature and rotation as well as 'non-systematic errors' attributed to satellite receiving station itself. Raw digital images contain geometric

distortions, which make them unusable as maps. Therefore, geo-referencing is required for correction of image data using ground control points (GCP) to make it compatible to Sol toposheet.

- **Image enhancement:**

To improve the interpretability of the raw data, image enhancement is necessary. Local operations modify the value of each pixel based on brightness value of neighbouring pixels using ERDAS IMAGINE v 2014 s/w / PCI Geomatica s/w and enhance the image quality for interpretation.

- **Training set selection**

Training set requires to be selected, so that software can classify the image data accurately. The image data are analysed based on the interpretation keys. These keys are evolved from certain fundamental image-elements such as tone/colour, size, shape, texture, pattern, location, association and shadow. Based on the image-elements and other geo-technical elements like land form, drainage pattern and physiography; training sets were selected/identified for each land use/cover class. Field survey was carried out by taking selective traverses in order to collect the ground information (or reference data) so that training sets are selected accurately in the image. This was intended to serve as an aid for classification.

- **Classification and Accuracy assessment**

Image classification is carried out using the maximum likelihood algorithm. The classification proceeds through the following steps: (a) calculation of statistics [i.e. signature generation] for the identified training areas, and (b) the decision boundary of maximum probability based on the mean vector, variance, covariance and correlation matrix of the pixels. After evaluating the statistical parameters of the training sets, reliability test of training sets is conducted by measuring the statistical separation between the classes that resulted from computing divergence matrix. The overall accuracy of the classification was finally assessed with reference to ground truth data.

- **Area calculation**

The area of each land use class in the leasehold is determined using ERDAS IMAGINE v2014 s/w.

- **Overlay of Vector data base**

Vector data base created based on secondary data. Vector layer like drainage, railway line, leasehold boundary, forest boundary etc. are superimposed on the image as vector layer in the Arc GIS database.

- **Pre-field map preparation**

Pre-field map is prepared for validation of the classification result

3.3 Ground Truthing:

Selective ground verification of the land use classes are carried out in the field and necessary corrections if required, are incorporated before map finalization.

3.4 Land reclamation database on GIS:

Land reclamation database is created on GIS platform to identify the temporal changes identified from satellite data of different cut-off dates.

4.0 Work Plan

- 4.1** Total 27 opencast projects subsidiaries producing less than 5 million cubic m(Coal +OB) and 08 clusters of different subsidiaries were taken up for the study during the year 2019 -20. Based on the RESOURCESAT-2 satellite data, land reclamation /mine closure monitoring was carried out using ERDAS IMAGINE digital image processing s/w and Arc-Info GIS.

4.2 The list of 27 opencast project producing less than 5 mcm (Coal and OB together) annually of different CIL subsidiaries and 08 clusters of BCCL & ECL taken up for Land Reclamation monitoring based on satellite data of year 2019 is given in table below :

Subsidiary (No. of Projects)	Opencast Projects (Less than 5 million Cu.m. Coal +OB per annum)
WCL (11)	Yekona-I&II , New Majri UG to OC, Pauni - II , Gokul , Singhori, Bhanegaon, Makardhokra-II , New Sethia , Ghugus , Pimpalgaon and Datla OCPs.
SECL (04)	Kotma, Mahan, Amgaon and West Chirimiri.
CCL (11)	Ara, Bhurkunda, Pichri, Pindra, Sirka, Dhori, Bokaro, Kargali, Rajhara, Religera and Sarubera.
BCCL (04)	Cluster-II , Cluster-VI, Cluster –XIV and Cluster –XVI.
ECL (04)	Cluster-IX, Cluster-X, Cluster –XI and Cluster –XII.
MCL (01)	Gopalji OC.
TOTAL (35)	

Subsidiary wise land reclamation status of the above mentioned 27 OC projects and 08 clusters of BCCL & ECL derived from satellite data for the year 2019 are given in the following pages:

CENTRAL COALFIELDS LIMITED

7.0 Land Reclamation Status in Central Coalfields Limited

7.1 Following 11 OC Projects of CCL producing less than 5 million m³ (Coal +OB) annually were taken up for Land Reclamation monitoring based on satellite data of the year 2019.

- Ara
- Bhurkunda
- Pichri
- Pindra
- Sirka
- Dhori
- Bokaro
- Kargali
- Rajhara
- Religera
- Sarubera

7.2 Project wise Land Reclamation status in CCL is given in Table 7.1 and also shown graphically in Fig 7.1. Area statistics of different land use class present in the mine leasehold of the above projects for the year 2019 are shown in the Table - 7.2. Land use maps derived from satellite data are shown in Plate 7.1 – 7.11. Different land use classes based on satellite data are depicted in Bar Charts in Fig.7.2 - 7.12.

7.3 Study reveals that out of total mine leasehold area of 5576.06 Hectares of the 11 OC projects of CCL mentioned above taken for this study in 2019-20; total excavated area is 897.34 hectares, out of which 158.26 Hectare area (17.64%) has been planted (*Biologically Reclaimed*), 219.64 Hectare area (24.48%) is under backfilling (*Technically Reclaimed*) and balance 519.44 hectares (57.89%) is under active mining. There is an increase of 166.38 hectare in overall area under reclamation in the above projects of CCL as compared to previous study undertaken in the year 2016-2017. This increase of 168.38 Hectare in area under reclamation includes both 39.34 Ha increase in plantation on backfill (Biological Reclamation) and 127.04 Ha increase in area under backfilling (Technical reclamation).

- 7.4** Study indicates that overall all the projects of CCL considered for this study indicate increase or static trend in area under backfilling (Technical Reclamation) with respect to the year 2016 except in Bokaro OC where area under technical reclamation has reduced from 69.32 hectare in the year 2016 to 58.84 Hectare in the year 2019 resulting which area under reclamation has reduced from 170.34 Ha to 156.80 Ha .This decrease of 10.48 hectare area under backfilling in Bokaro OC is due to some of the area under backfilling has been occupied by water logging.
- 7.5** There has been increase in area under plantation on backfill (Biological Reclamation) in all projects of CCL considered for this study in the year 2019 except in Dhori OC and Bokaro OC where minor decrease of 1.68 Hectare area under biological reclamation in Dhori OC and 3.06 Hectare in Bokaro OC in the span of three year is due to expansion of mining area. Plantation on backfill (Biological Reclamation) in Ara OC, Pichri OC, Pindra OC, Rajhara OC, Religera OC and Sarubera OC has not been started as yet. However , overall increase in Biological Reclamation is estimated to 158.26 Hectare in the year 2019 as compared to 118.92 Hectare in the year 2016.
- 7.6** After analyzing the satellite data of the year 2016 and 2019 It is evident that total area under plantation (Green cover) carried out on backfill area , OB dumps as well as under social forestry in all the mines of CCL has increased from 808.11 Ha to 835.34 Ha in span of last three year . This increase of 27.23 Hectare area of plantation (Green cover) in three year is due to sincere effort of CCL towards mine land reclamation and environment protection.
- 7.7** Area of plantation on OB has decreased in Ara, Bhurkunda and Religera OC, resulting which total area under plantation has decreased from 86.03 hectare (Yr.2016) to 84.28 hectare (Yr.2019) in the Ara OC, 234.91 Ha (Yr 2016) to 226.94 hectare (Yr.2019) in Bhurkunda OC and 42.88 Hectare (Yr.2016) to 41.92 hectare in Religera OC respectively. The decrease of 54.20 hectare area under plantation on OB in Bhurkunda OC is due to advancement in mining area .The minor decrease of 0.83 Ha area under plantation on OB in Religera OC is due to increase in active mining area.

- 7.8** Out of eleven projects of CCL taken for this study , Bokaro OCP ranks top for land reclamation (72.09%) followed by Dhori OCP (67.41%) and Bhurkunda (48.72%)
- 7.9** This study will again will be carried out after an interval of three years to assess the land reclamation status in the above projects.

Table 7.1 Project wise Land Reclamation Status in Opencast Projects of CCL based on the Satellite data of the year 2019

(Area in Hectare)

Sl. No.	Project	Total Leasehold Area		Technical Reclamation		Plantation						Area under Active Mining		Total Excavated Area		Total Area under Plantation (% Green Cover Generated in Leasehold)		Total Area under Reclamation	
						Biological Reclamation		Other Plantations											
						Area under Backfilling		Plantation on Excavated / Backfilled Area		Plantation on External Over Burden Dumps									
1	2	3		4		5		6		7		8		9 (=4+5+8)		10 (=5+6+7)		11(=4+5)	
		2016	2019	2016	2019	2016	2019	2016	2019	2016	2019	2016	2019	2016	2019	2016	2019	2016	2019
1	Ara	525.75	525.75	0.00	0.00	0.00	0.00	84.10	82.35	1.93	1.93	50.44	51.72	50.44	51.72	86.03	84.28	0.00	0.00
				0.00%	0.00%	0.00%	0.00%					100.00%	100.00%			16.36%	16.03%	0.00%	0.00%
2	Bhurkunda	910.16	910.16	3.75	32.11	0.00	41.12	140.72	86.52	94.19	99.30	100.70	77.07	104.45	150.30	234.91	226.94	3.75	73.23
				3.59%	21.36%	0.00%	27.36%					96.41%	51.28%			25.81%	24.93%	3.59%	48.72%
3	Pichri	40.13	40.13	0.00	0.00	0.00	0.00	0.00	0.00	8.25	8.25	13.19	13.19	13.19	13.19	8.25	8.25	0.00	0.00
				0.00%	0.00%	0.00%	0.00%					100.00%	100.00%			20.56%	20.56%	0.00%	0.00%
4	Pindra	326.54	326.54	0.00	0.00	0.00	0.00	0.00	0.00	3.86	5.43	24.71	29.40	24.71	29.40	3.86	5.43	0.00	0.00
				0.00%	0.00%	0.00%	0.00%					100.00%	100.00%			1.18%	1.66%	0.00%	0.00%
5	Sirka	362.40	362.40	0.00	22.02	0.00	2.96	4.53	0.00	6.08	6.07	89.61	65.74	89.61	90.72	10.61	9.03	0.00	24.98
				0.00%	24.27%	0.00%	3.26%					100.00%	72.46%			2.93%	2.49%	0.00%	27.54%
6	Dhori	294.32	294.32	17.92	30.53	16.16	14.48	6.66	14.30	0.00	0.00	29.79	21.76	63.87	66.77	22.82	28.78	34.08	45.01
				28.06%	45.72%	25.30%	21.69%					46.64%	32.59%			7.75%	9.78%	53.36%	67.41%
7	Bokaro	607.30	607.30	69.32	58.84	101.02	97.96	5.45	13.22	58.54	58.79	48.89	60.72	219.23	217.52	165.01	169.97	170.34	156.80
				31.62%	27.05%	46.08%	45.03%					22.30%	27.91%			27.17%	27.99%	77.70%	72.09%
8	Kargali	785.00	785.00	0.12	29.97	1.74	1.74	103.53	106.89	72.96	85.70	102.08	78.18	103.94	109.89	178.23	194.33	1.86	31.71
				0.12%	27.27%	1.67%	1.58%					98.21%	71.14%			22.70%	24.76%	1.79%	28.86%
9	Rajhara	736.36	736.36	0.00	8.66	0.00	0.00	0.00	7.63	0.00	2.27	53.46	32.27	53.46	40.93	0.00	9.90	0.00	8.66
				0.00%	21.16%	0.00%	0.00%					100.00%	78.84%			0.00%	1.34%	0.00%	21.16%
10	Religera	301.75	301.75	0.00	36.02	0.00	0.00	9.73	8.90	33.15	33.02	57.11	60.21	57.11	96.23	42.88	41.92	0.00	36.02
				0.00%	37.43%	0.00%	0.00%					100.00%	62.57%			14.21%	13.89%	0.00%	37.43%
11	Sarubera	686.35	686.35	1.49	1.49	0.00	0.00	49.50	50.50	6.01	6.01	27.56	29.17	29.05	30.66	55.51	56.51	1.49	1.49
				5.13%	4.86%	0.00%	0.00%					94.87%	95.14%			8.09%	8.23%	5.13%	4.86%
TOTAL		5576.06	5576.06	92.60	219.64	118.92	158.26	404.22	370.31	284.97	306.77	597.54	519.43	809.06	897.33	808.11	835.34	211.52	377.90
				11.45%	24.48%	14.70%	17.64%					73.86%	57.88%			14.49%	14.98%	26.14%	42.11%

(% is calculated with respected to Excavated Area as applicable)

Note: In reference to above table different parameters as classified as follows:

1. Area under Biological Reclamation includes Area under plantation done on Backfilled Area only.
2. Area under Technical Reclamation includes Area under Backfill only.
3. Area under Active mining includes Coal Quarry, Advance Quarry site and Quarry filled with water etc if any.
4. Social Forestry and Plantation on External OB Dumps are not included in Biological Reclamation and are put under separate categories as shown in above Table.
5. (%) calculated in above Table is in respect to Total Excavated area except for " Total Area under plantation " where % is in terms of "Leasehold Area " .

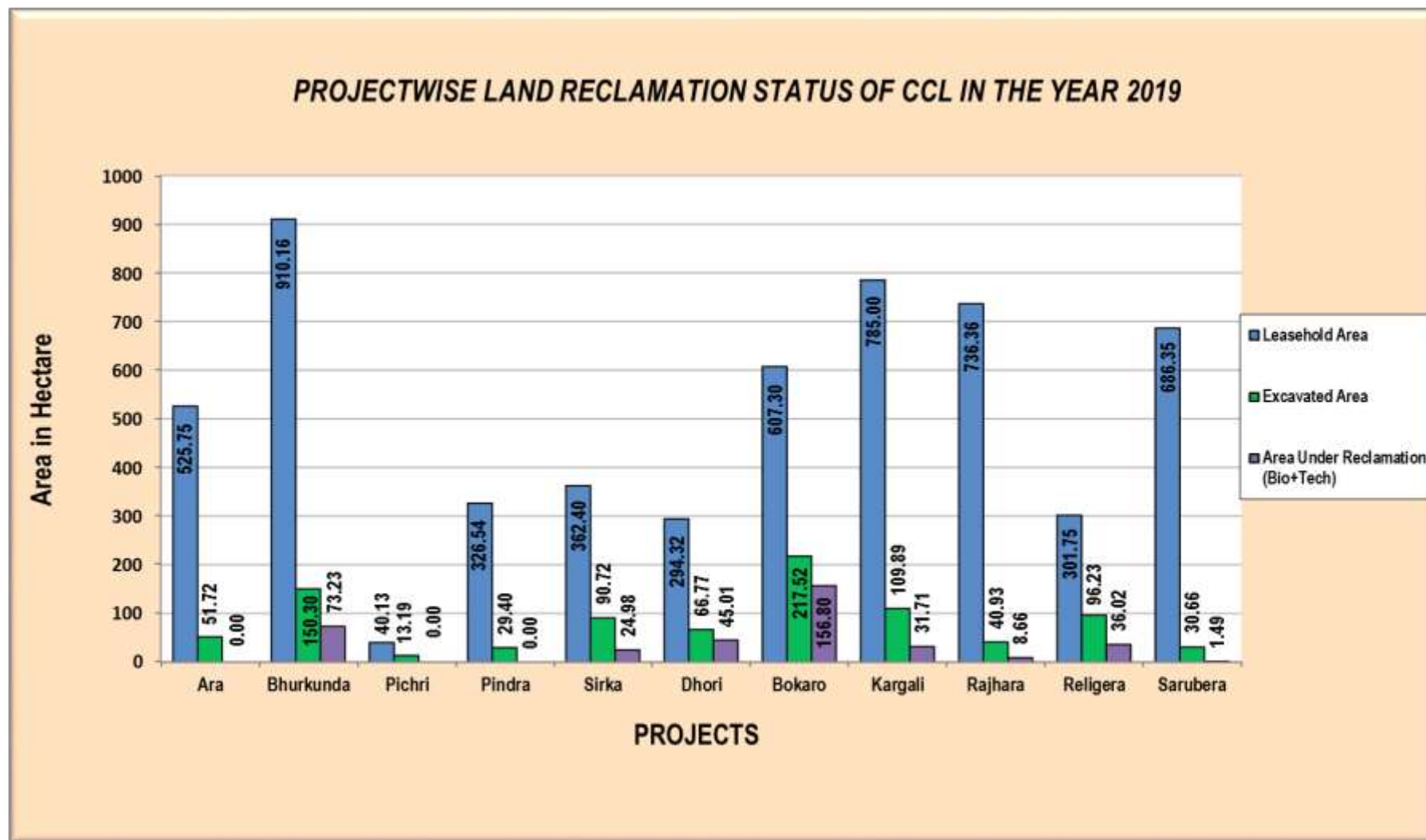
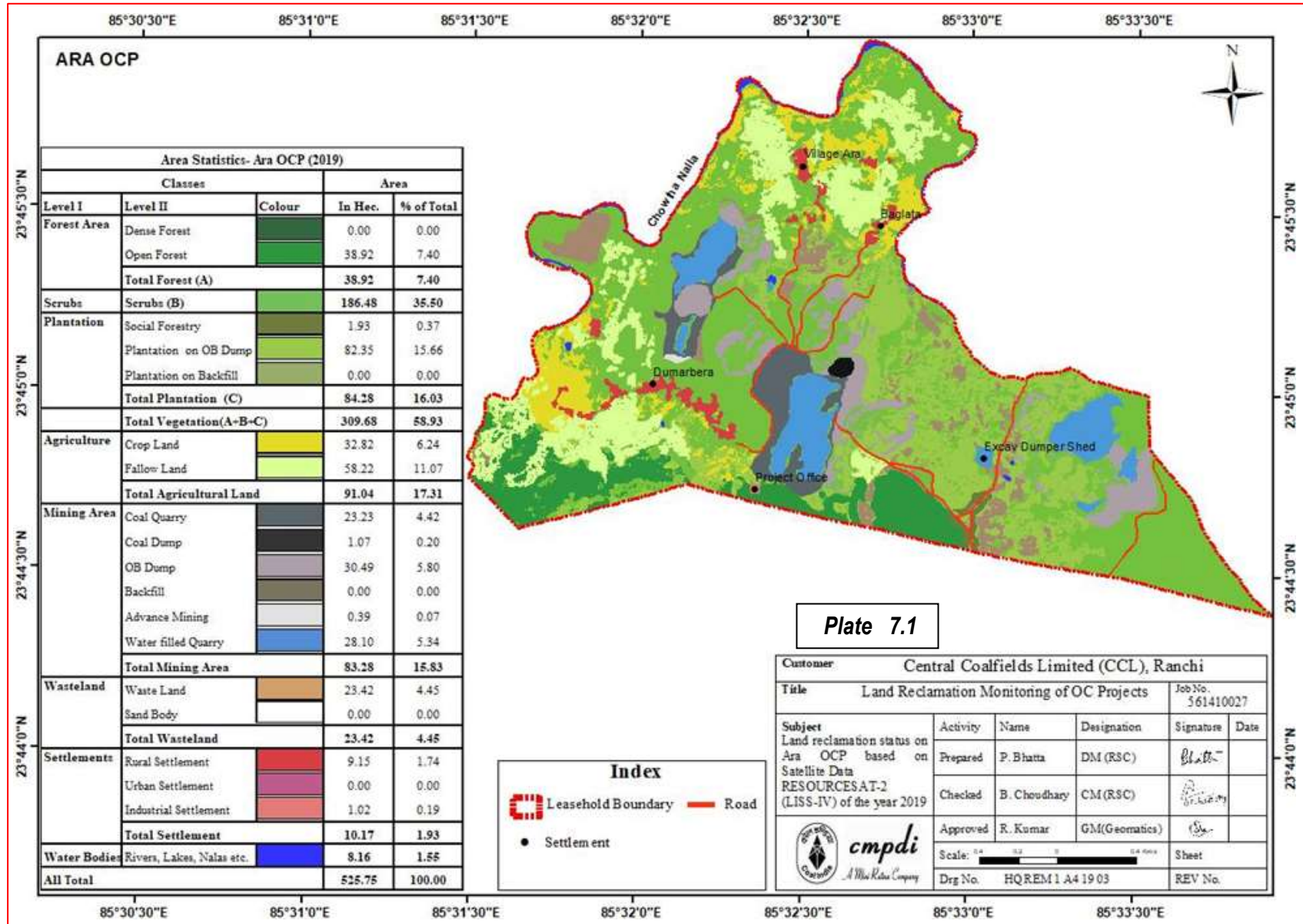


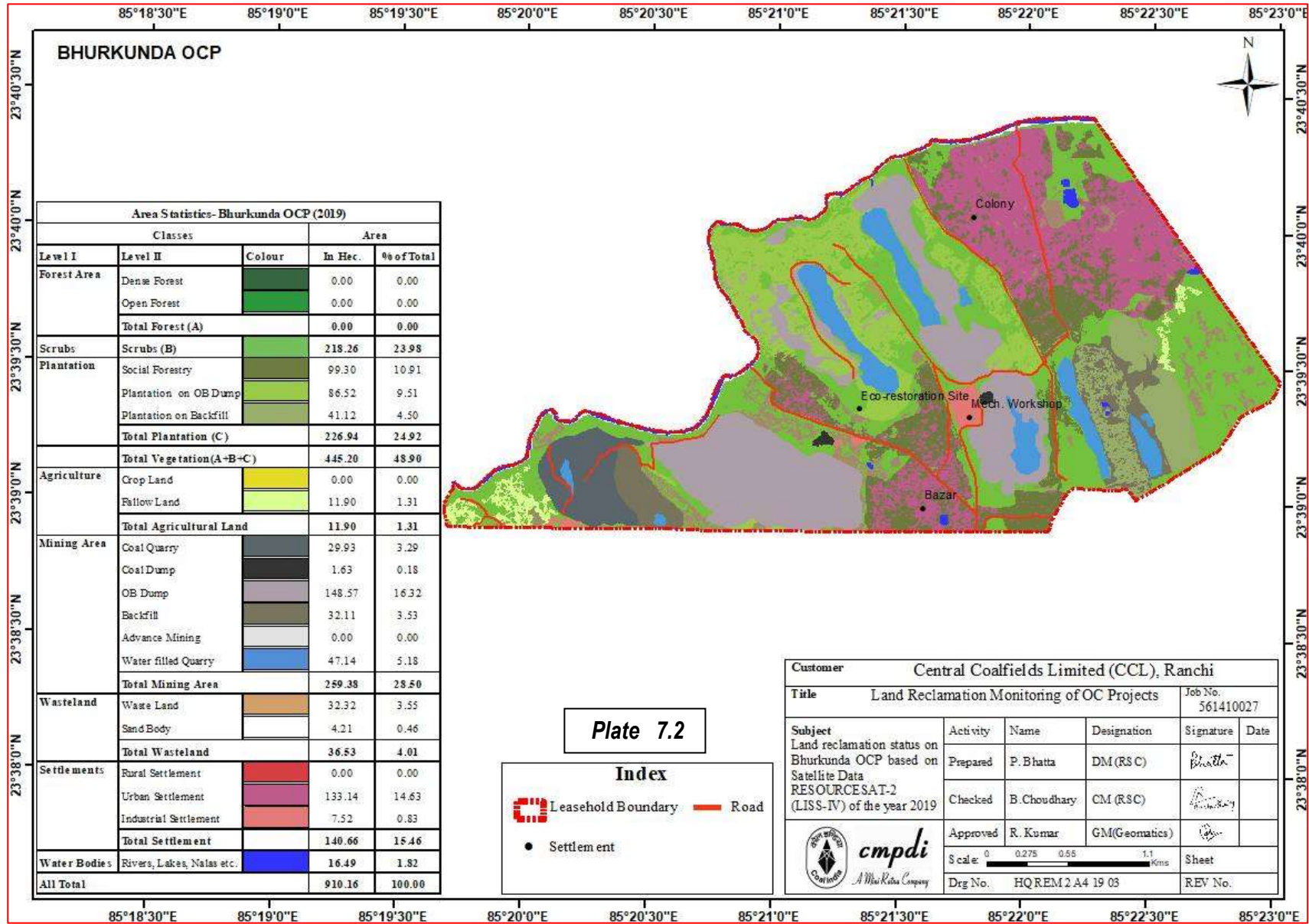
Figure7.1: Project wise Land Reclamation status in OC Projects producing less than 5 mcm (Coal+OB) of CCL in the year 2019

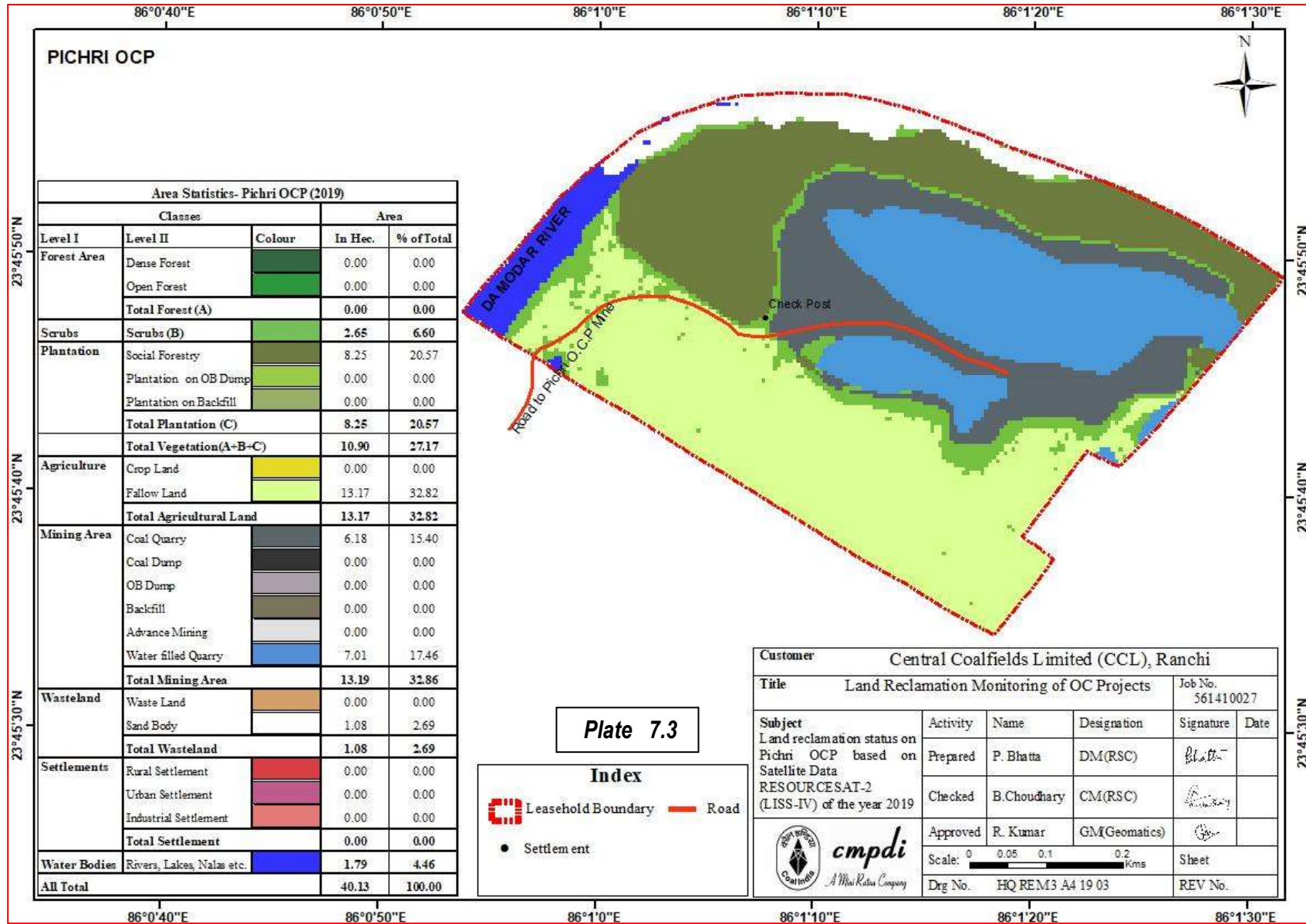
TABLE: 7.1 PROJECTWISE AREA STATISTICS OF LAND USE/COVER CLASSES IN PROJECTS OF CCL BASED ON SATELLITE DATA OF THE YEAR 2019

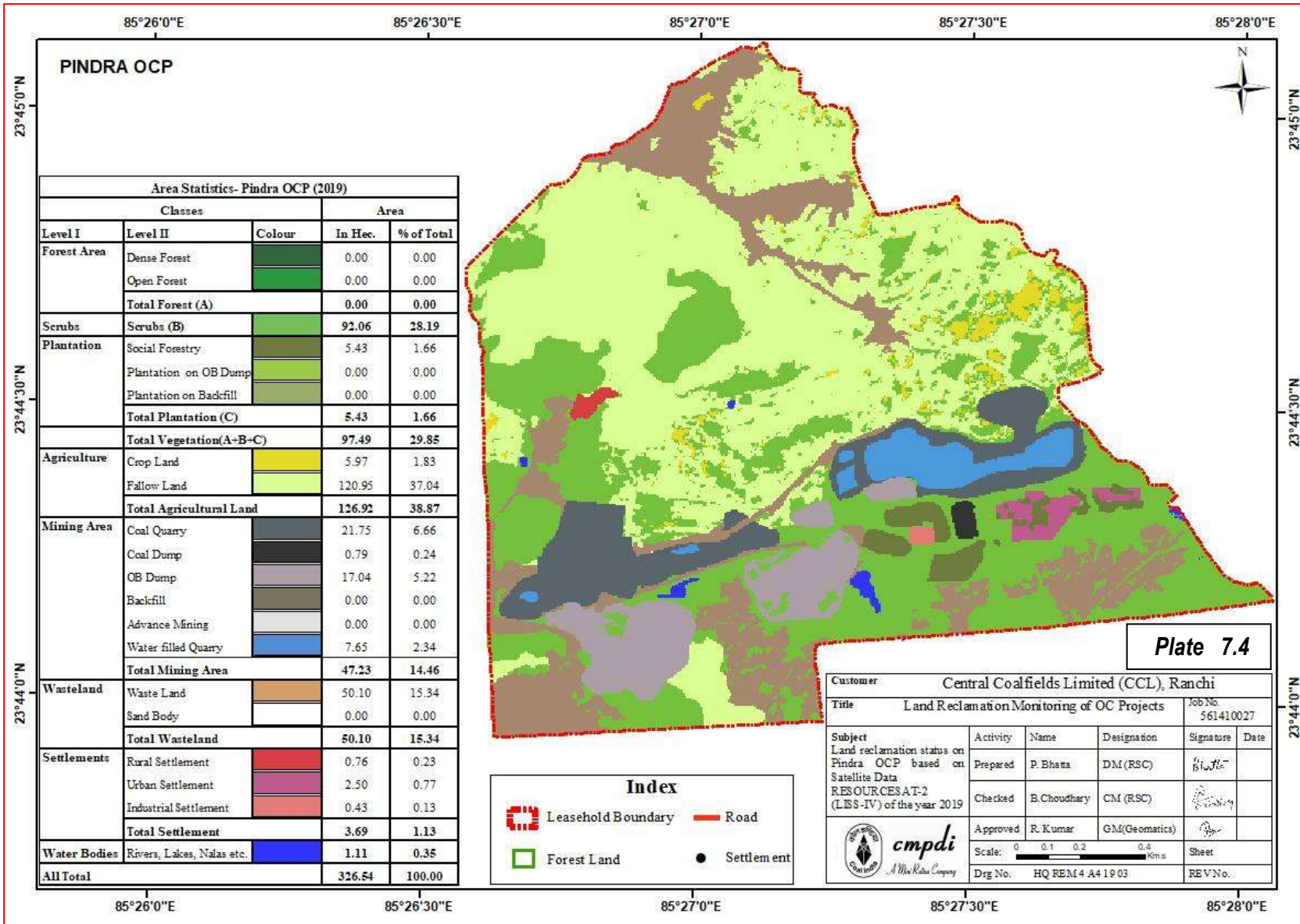
(Area in Hectare)

		ARA		BHURKUNDA		PICHRI		PINDRA		SIRKA		DHORI		BOKARO		KARGALI		RAJHARA		RELIGERA		SARUBERA		TOTAL	
		Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%
FORESTS	Dense Forest	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Open Forest	38.92	7.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.69	1.59	1.11	0.37	54.32	7.91	106.04	1.90
	Total Forest (A)	38.92	7.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.69	1.59	1.11	0.37	54.32	7.91	106.04
SCRUBS	Scrubs (B)	186.48	35.50	218.26	23.98	2.65	6.60	92.06	28.19	80.56	22.23	86.95	29.54	111.80	18.40	163.55	20.83	215.75	29.29	78.53	26.02	135.46	19.74	1372.05	24.61
PLANTATION	Social Forestry	1.93	0.37	99.30	10.91	8.25	20.57	5.43	1.66	6.07	1.67	0.00	0.00	58.79	9.68	85.70	10.92	2.27	0.31	33.02	10.93	6.01	0.87	306.77	5.50
	Plantation on External OB Dump	82.35	15.66	86.52	9.51	0.00	0.00	0.00	0.00	0.00	0.00	14.30	4.86	13.22	2.18	106.89	13.62	7.63	1.04	8.90	2.95	50.50	7.36	370.31	6.64
	Plantation on Backfill (Biological Reclamation)	0.00	0.00	41.12	4.50	0.00	0.00	0.00	0.00	2.96	0.82	14.48	4.92	97.96	16.13	1.74	0.22	0.00	0.00	0.00	0.00	0.00	0.00	158.26	2.84
	Total Plantation (Green Cover) (C)	84.28	16.03	226.94	24.92	8.25	20.57	5.43	1.66	9.03	2.49	28.78	9.78	169.97	27.99	194.33	24.76	9.90	1.35	41.92	13.88	56.51	8.23	835.34	14.98
Total Vegetation (A+B+C)	309.68	58.93	445.20	48.90	10.90	27.17	97.49	29.85	89.59	24.72	115.73	39.32	281.77	46.39	357.88	45.59	237.34	32.23	121.56	40.27	246.29	35.88	2313.43	41.49	
ACTIVE MINING	Coal Dump	1.07	0.20	1.63	0.18	0.00	0.00	0.79	0.24	0.00	0.00	0.97	0.33	0.00	0.00	4.88	0.62	1.83	0.25	5.88	1.95	0.00	0.00	17.05	0.31
	Coal Quarry	23.23	4.42	29.93	3.29	6.18	15.40	21.75	6.66	56.31	15.54	7.99	2.71	8.07	1.33	30.67	3.91	13.47	1.83	29.71	9.85	15.94	2.32	243.25	4.36
	Advance Quarry Site	0.39	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.01
	Quarry Filled with Water	28.10	5.34	47.14	5.18	7.01	17.46	7.65	2.34	9.43	2.60	13.77	4.68	52.65	8.68	47.52	6.05	18.80	2.55	30.50	30.50	13.23	1.93	275.80	4.95
	Total Area under Active Mining	51.72	9.83	77.07	8.47	13.19	32.86	29.40	9.00	65.74	18.14	21.76	7.39	60.72	10.01	78.19	9.96	32.27	4.38	60.21	40.36	29.17	4.25	519.44	9.32
MINE OPERATION	Barren OB dump	30.49	5.80	148.57	16.32	0.00	0.00	17.04	5.22	35.26	9.73	18.75	6.37	12.27	2.02	134.12	17.09	4.89	0.66	51.27	16.99	51.82	7.55	504.48	9.05
	Area Under Backfilling (Technical Reclamation)	0.00	0.00	32.11	3.53	0.00	0.00	0.00	0.00	22.02	6.08	30.53	10.37	58.84	9.69	29.97	3.82	8.66	1.18	36.02	11.94	1.49	0.22	219.64	3.94
	Total Area under Mine Operation	83.28	15.83	259.38	28.50	13.19	32.86	47.23	14.46	123.02	33.95	72.01	24.46	131.83	21.72	247.16	31.49	47.65	6.47	153.38	50.84	82.48	12.02	1260.61	22.61
WASTELANDS	Waste Lands	23.42	4.45	32.32	3.55	0.00	0.00	50.10	15.34	17.12	4.72	15.15	5.15	14.40	2.37	4.45	0.57	140.65	19.10	2.46	0.82	161.40	23.52	461.47	8.28
	Fly Ash Pond/Sand Body	0.00	0.00	4.21	0.46	1.08	2.69	0.00	0.00	8.15	2.25	4.97	1.69	42.09	6.93	0.00	0.00	26.82	3.64	0.00	0.00	0.00	0.00	87.32	1.57
	Total Wastelands	23.42	4.45	36.53	4.01	1.08	2.69	50.10	15.34	25.27	6.97	20.12	6.84	56.49	9.30	4.45	0.57	167.47	22.74	2.46	0.82	161.40	23.52	548.79	9.84
WATER	Reservoir, nallah, ponds etc.	8.16	1.55	16.49	1.82	1.79	4.46	1.11	0.35	9.86	2.72	4.92	1.68	20.81	3.42	2.43	0.30	26.64	3.62	0.38	0.13	5.69	0.83	98.28	1.76
	Total Waterbodies	8.16	1.55	16.49	1.82	1.79	4.46	1.11	0.35	9.86	2.72	4.92	1.68	20.81	3.42	2.43	0.30	26.64	3.62	0.38	0.13	5.69	0.83	98.28	1.76
AGRICULTURE	Crop Lands	32.82	6.24	0.00	0.00	0.00	0.00	5.97	1.83	13.74	3.79	0.00	0.00	0.00	0.00	0.00	0.00	55.93	7.60	0.00	0.00	30.17	4.40	138.63	2.49
	Fallow Lands	58.22	11.07	11.90	1.31	13.17	32.82	120.95	37.04	69.64	19.22	12.57	4.27	71.18	11.72	4.20	0.54	150.88	20.49	3.58	1.19	136.66	19.91	652.95	11.71
	Total Agriculture	91.04	17.31	11.90	1.31	13.17	32.82	126.92	38.87	83.38	23.01	12.57	4.27	71.18	11.72	4.20	0.54	206.81	28.09	3.58	1.19	166.83	24.31	791.58	14.20
SETTLEMENTS	Urban Settlement	0.00	0.00	133.14	14.63	0.00	0.00	2.50	0.77	22.46	6.20	61.70	20.96	29.34	4.83	129.61	16.51	0.00	0.00	12.26	4.06	0.00	0.00	391.01	7.01
	Rural Settlement	9.15	1.74	0.00	0.00	0.00	0.00	0.76	0.23	7.57	2.09	5.70	1.94	14.19	2.34	24.77	3.16	49.36	6.70	6.82	2.26	9.23	1.34	127.55	2.29
	Industrial Settlement	1.02	0.19	7.52	0.83	0.00	0.00	0.43	0.13	1.25	0.34	1.57	0.53	1.69	0.28	14.50	1.85	1.09	0.15	1.31	0.43	14.43	2.10	44.81	0.80
	Total Settlements	10.17	1.93	140.66	15.46	0.00	0.00	3.69	1.13	31.28	8.63	68.97	23.43	45.22	7.45	168.88	21.52	50.45	6.85	20.39	6.75	23.66	3.44	563.37	10.10
GRAND TOTAL	525.75	100.00	910.16	100.00	40.13	100.00	326.54	100.00	362.40	100.00	294.32	100.00	607.30	100.00	785.00	100.00	736.36	100.00	301.75	100.00	686.35	100.00	5576.06	100.00	









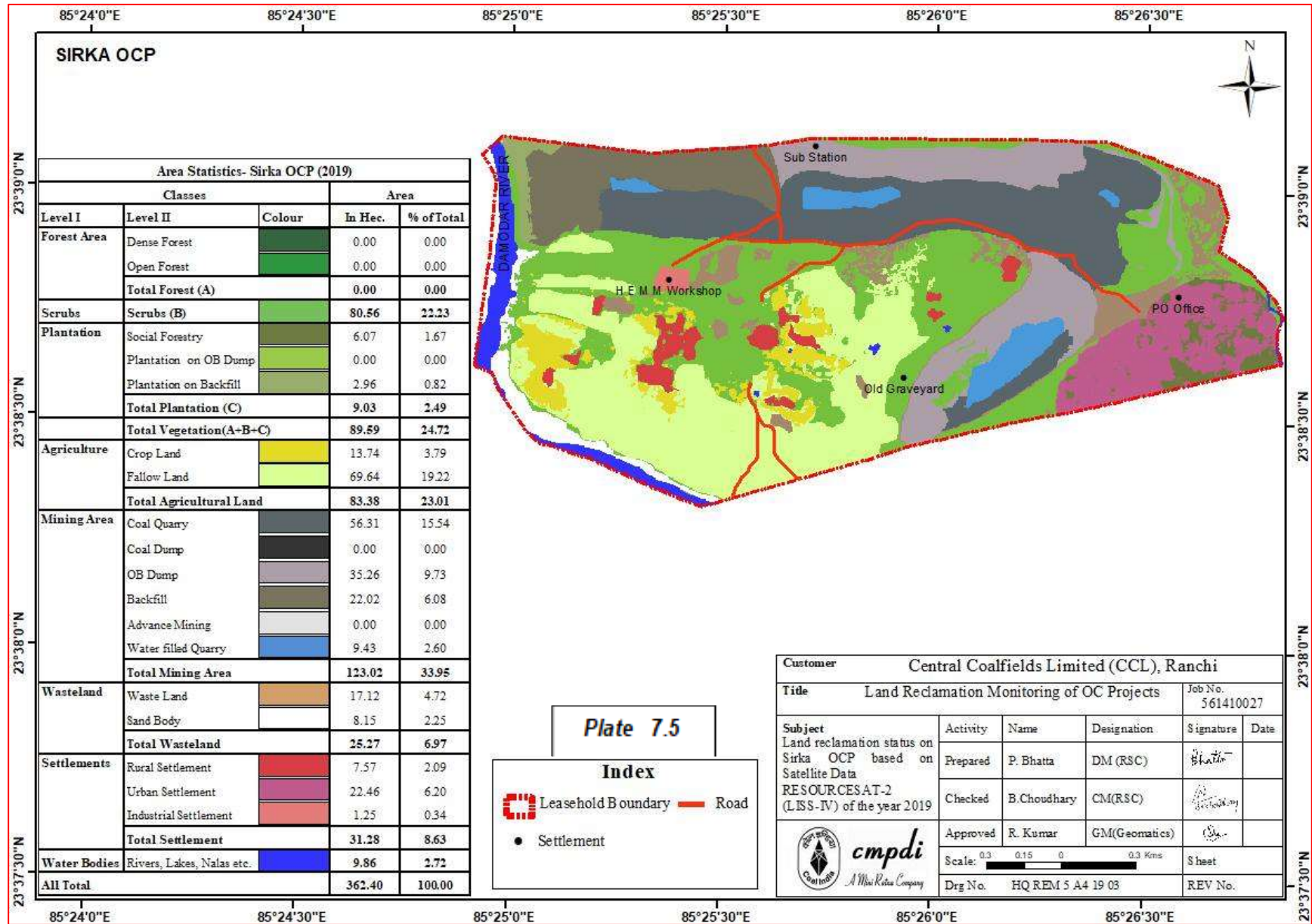


Plate 7.5

Index

- Leasehold Boundary
- Road
- Settlement

Customer						Central Coalfields Limited (CCL), Ranchi	
Title						Land Reclamation Monitoring of OC Projects	
						Job No.	561410027
Subject				Activity	Name	Designation	Signature
Land reclamation status on Sirka OCP based on Satellite Data				Prepared	P. Bhatta	DM (RSC)	
RESOURCESAT-2 (LISS-IV) of the year 2019				Checked	B.Choudhary	CM(RSC)	
				Approved	R. Kumar	GM(Geomatics)	
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				Drg No.	HQ REM 5 A4 19 03		REV No.

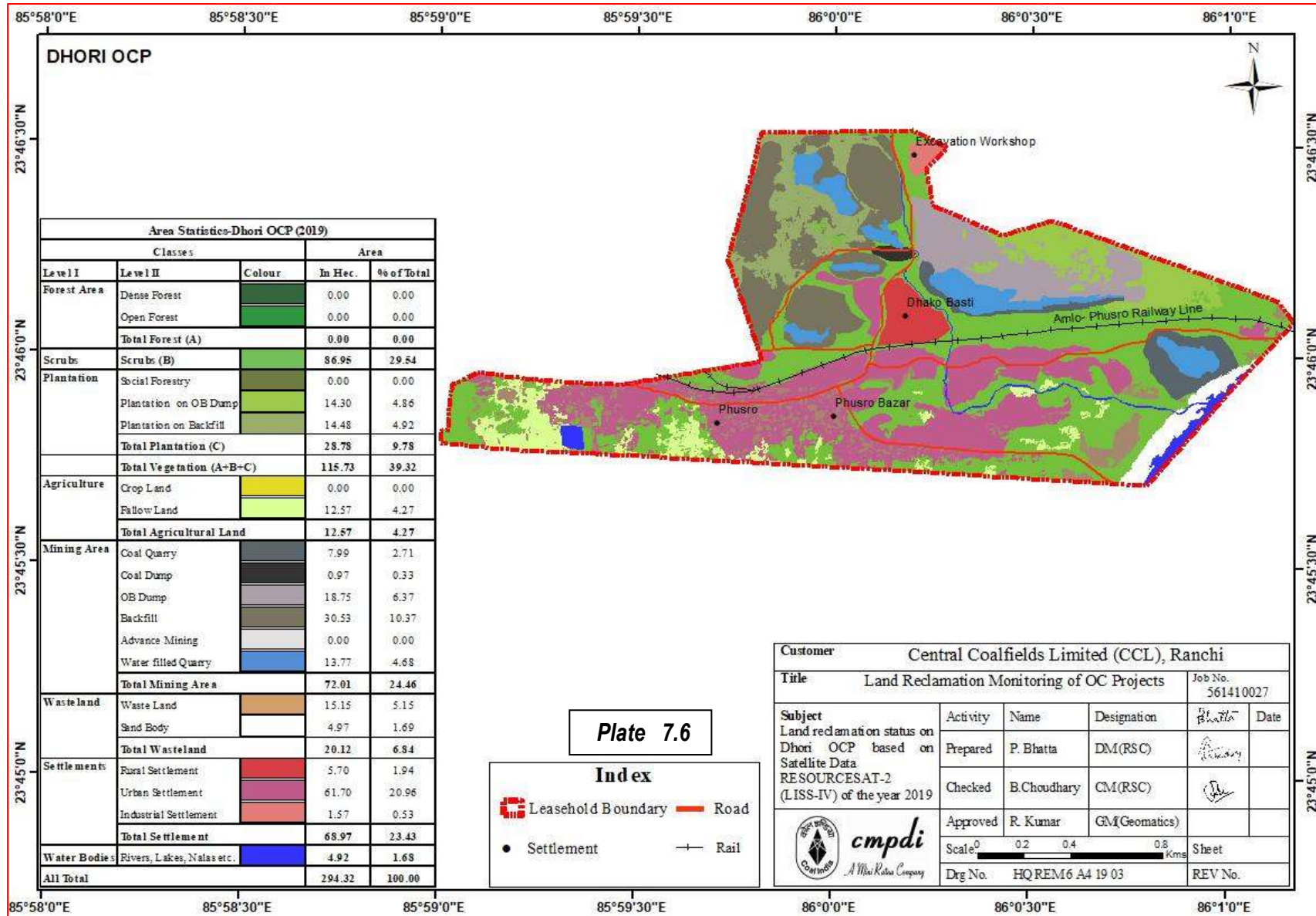
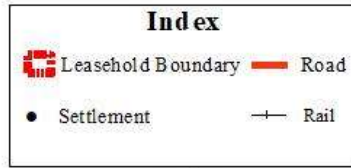


Plate 7.6



Customer		Central Coalfields Limited (CCL), Ranchi		
Title		Land Reclamation Monitoring of OC Projects		Job No. 561410027
Subject	Activity	Name	Designation	Date
	Prepared	P. Bhatta	DM(RSC)	
	Checked	B. Choudhary	CM(RSC)	
Approved	R. Kumar	GM(Geomatics)		
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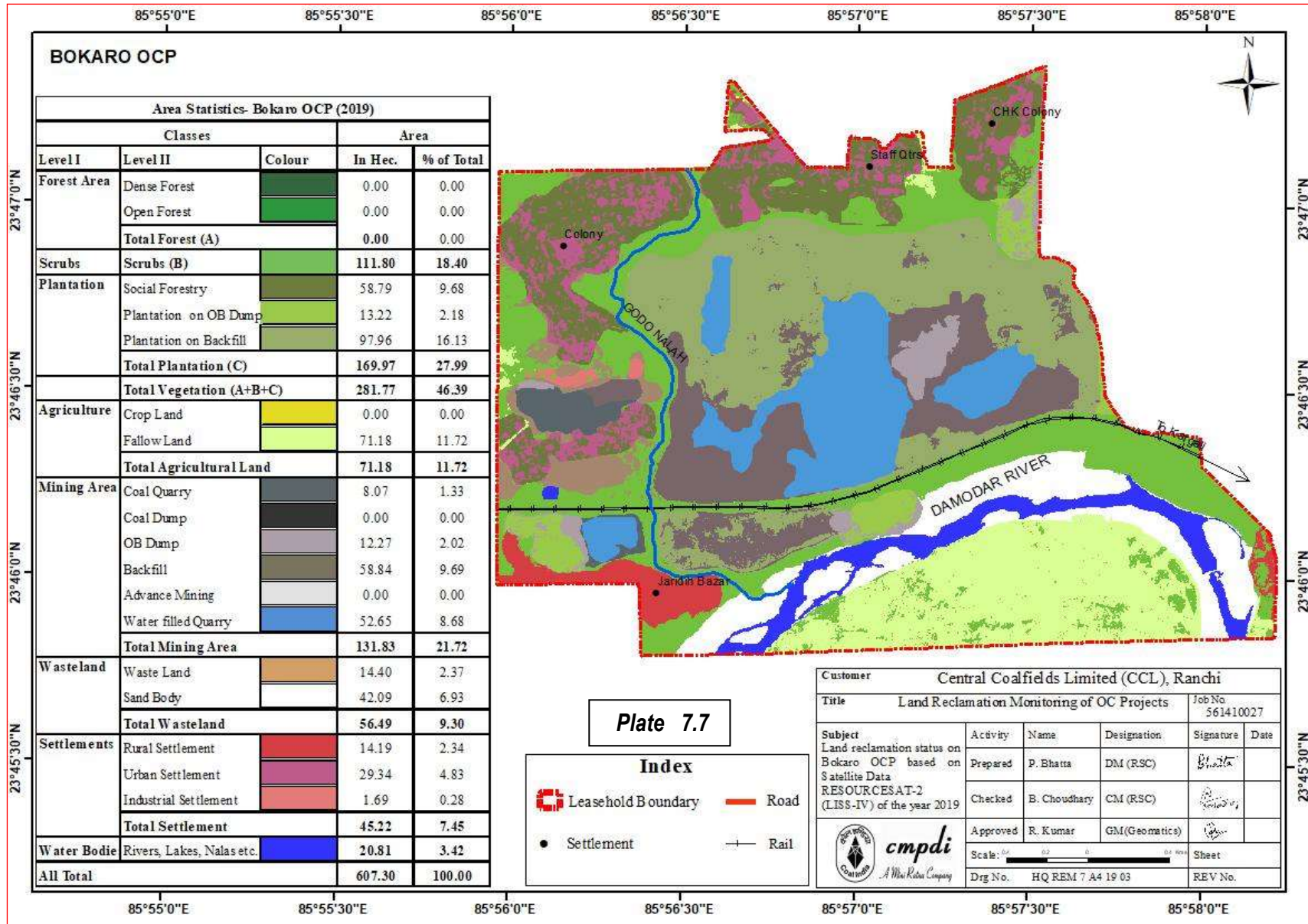
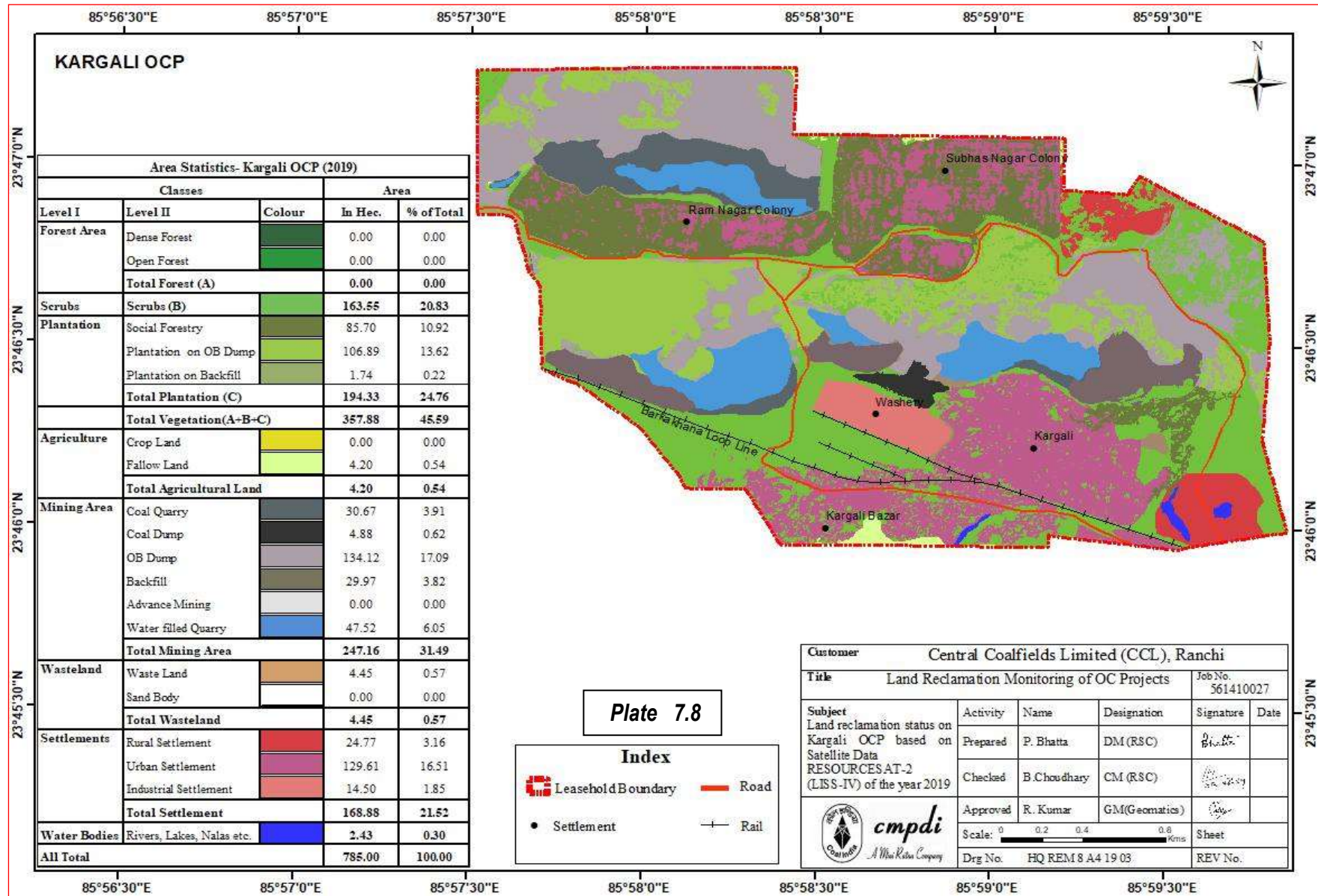


Plate 7.7

Index

- Leasehold Boundary
- Road
- Settlement
- Rail

Customer: Central Coalfields Limited (CCL), Ranchi					
Title: Land Reclamation Monitoring of OC Projects				Job No: 561410027	
Subject: Land reclamation status on Bokaro OCP based on Satellite Data RESOURCESAT-2 (LISS-IV) of the year 2019	Activity	Name	Designation	Signature	Date
	Prepared	P. Bhatta	DM (RSC)		
	Checked	B. Choudhary	CM (RSC)		
Approved	R. Kumar	GM (Geomatics)			
Scale: 1:50,000				Sheet	
Drg No. HQ REM 7 A4 19 03				REV No.	



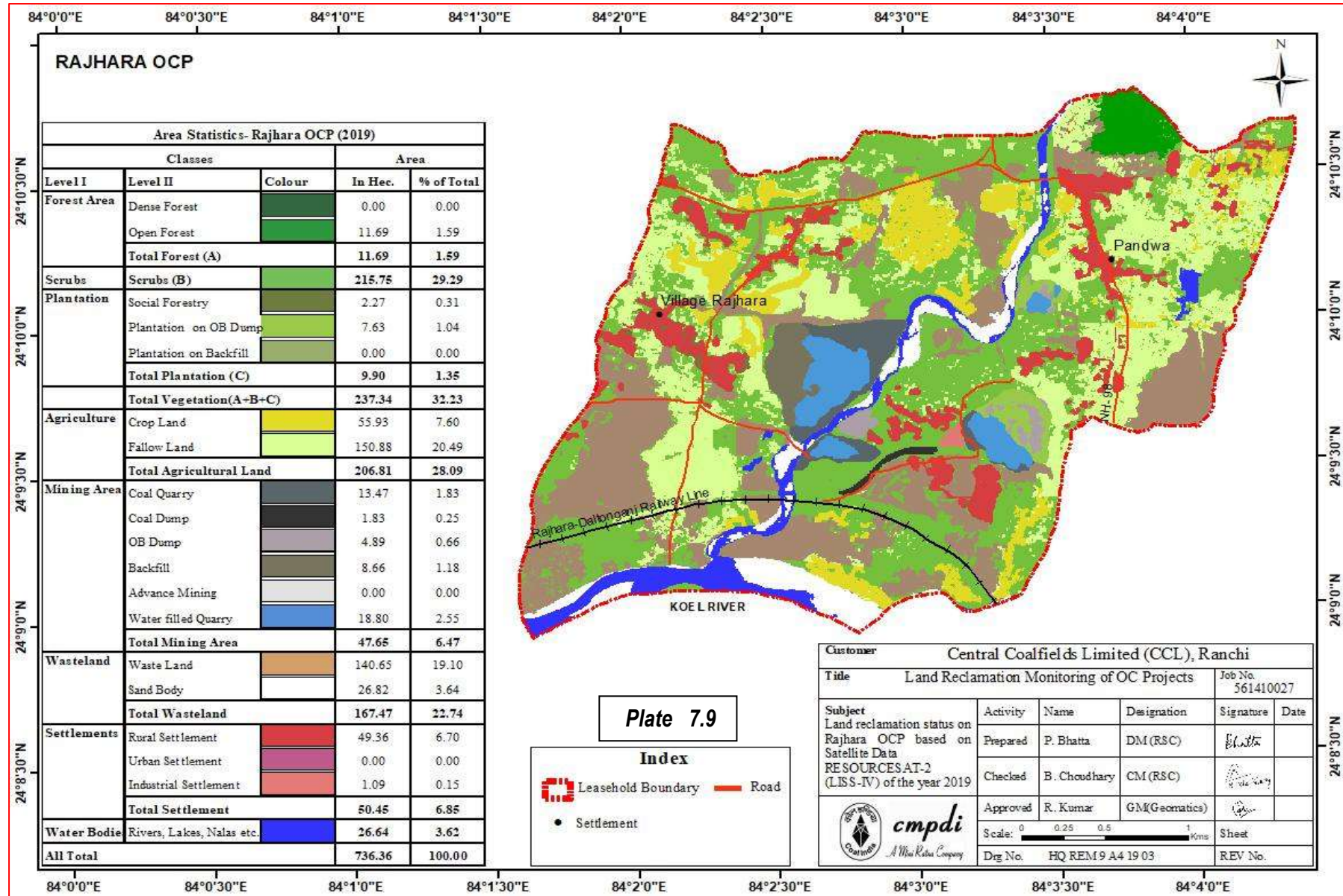
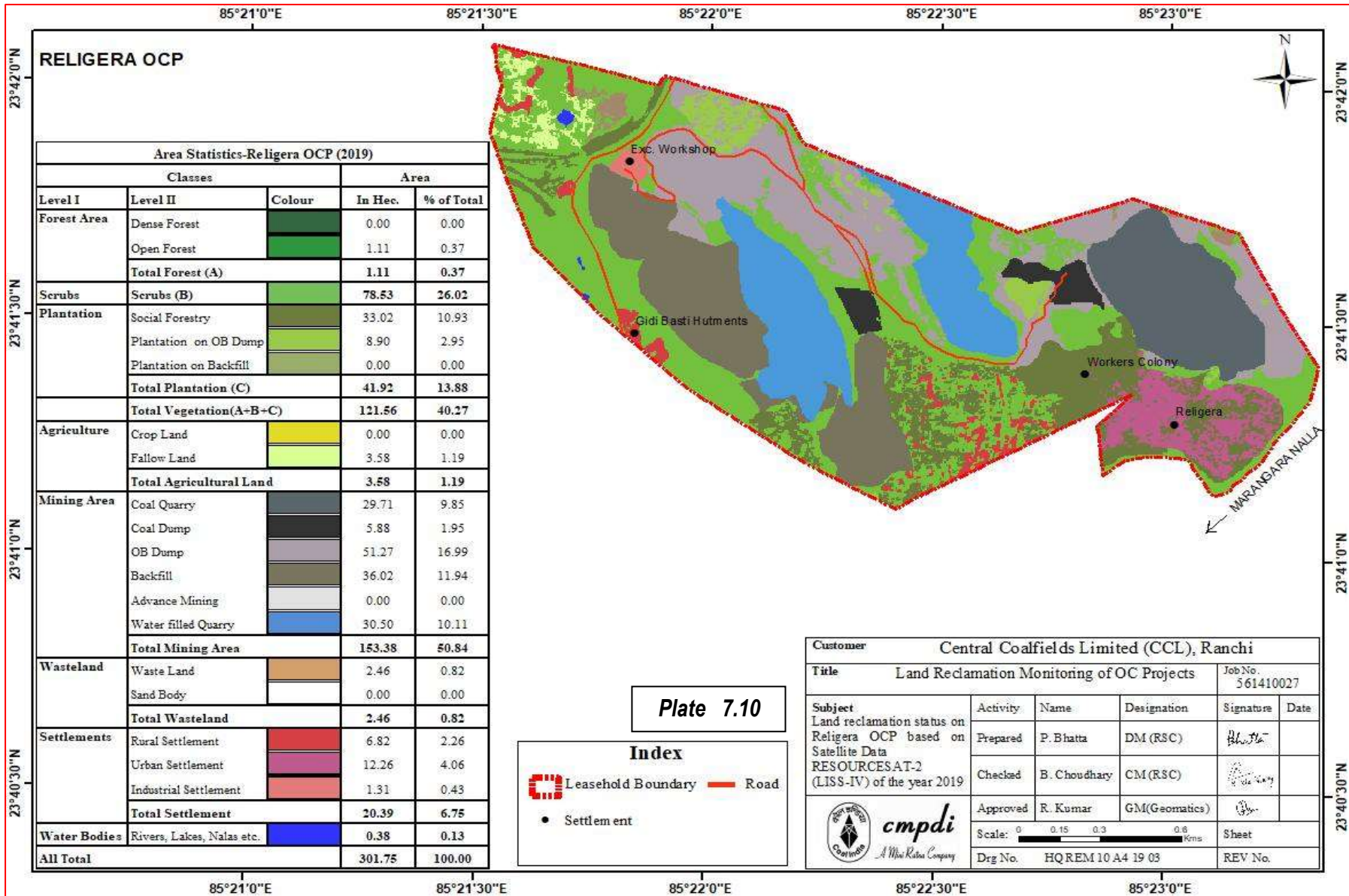


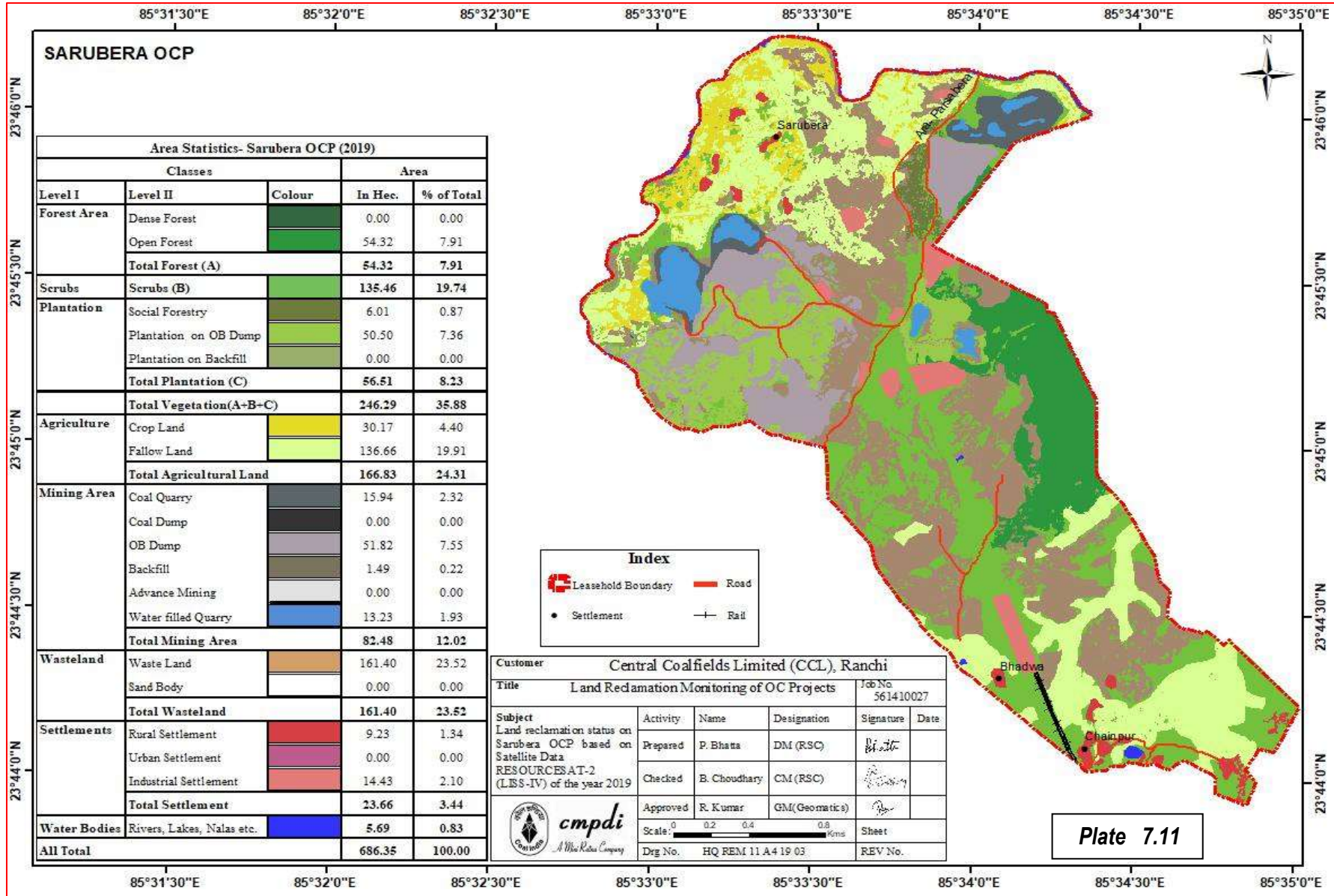
Plate 7.9

Index

- Leasehold Boundary
- Road
- Settlement

Customer: Central Coalfields Limited (CCL), Ranchi					
Title: Land Reclamation Monitoring of OC Projects				Job No. 561410027	
Subject: Land reclamation status on Rajhara OCP based on Satellite Data RESOURCESAT-2 (LISS-IV) of the year 2019	Activity	Name	Designation	Signature	Date
	Prepared	P. Bhatta	DM (RSC)		
	Checked	B. Choudhary	CM (RSC)		
	Approved	R. Kumar	GM(Geomatics)		
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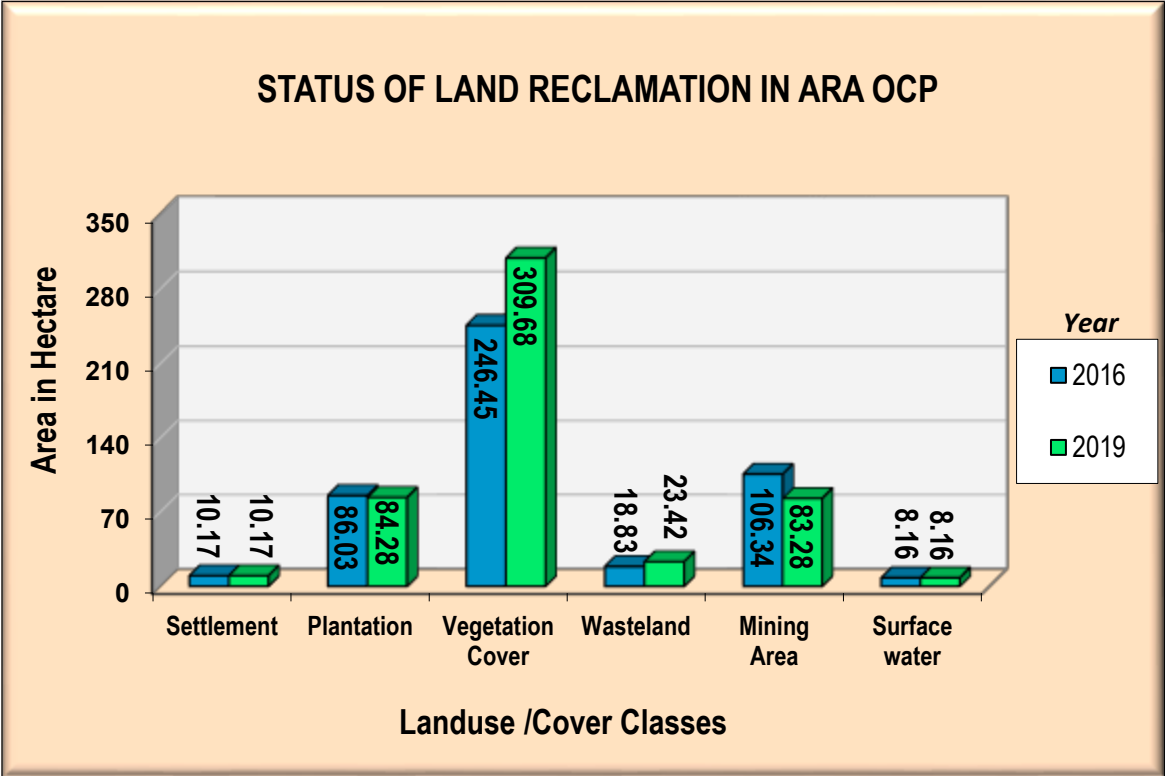


FIGURE – 7.2

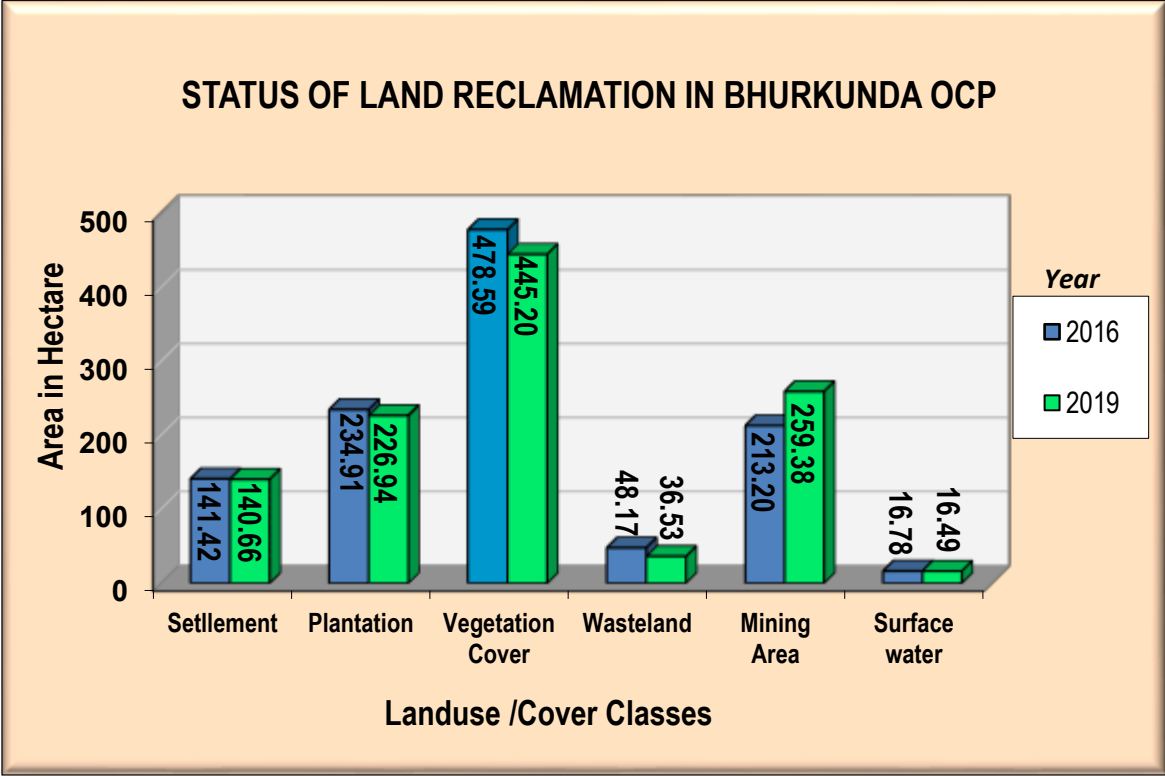


FIGURE – 7.3

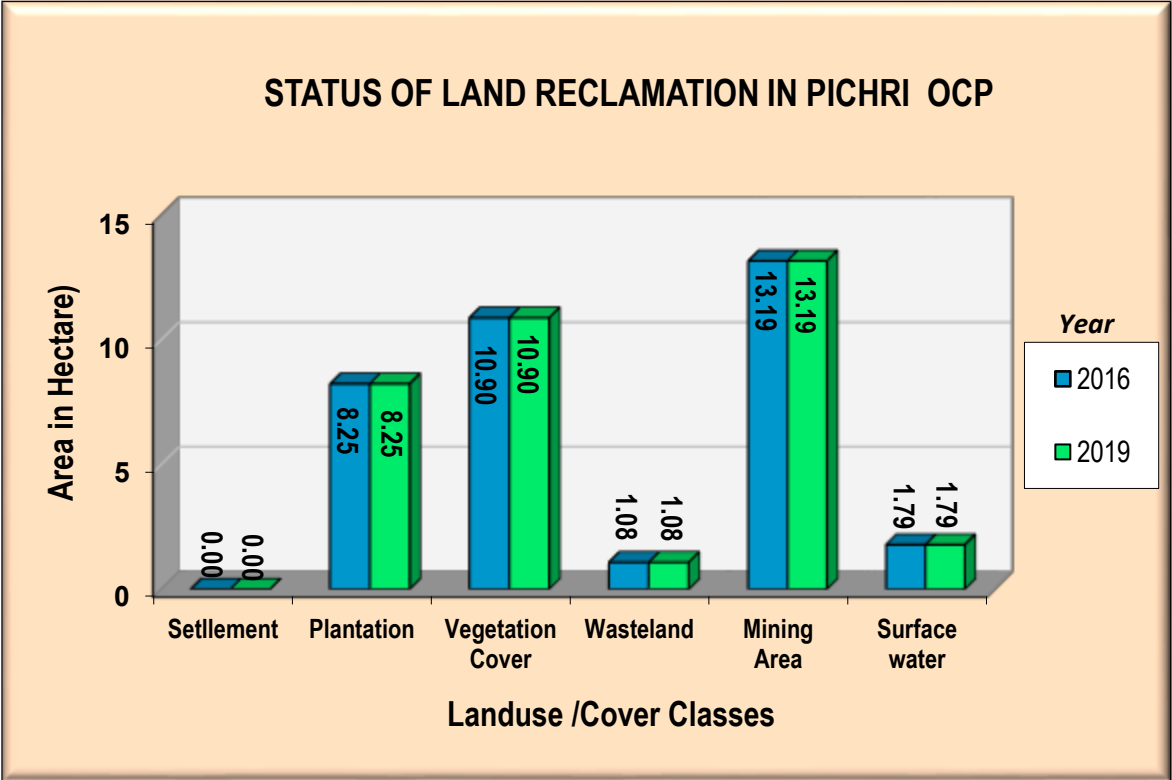


FIGURE – 7.4

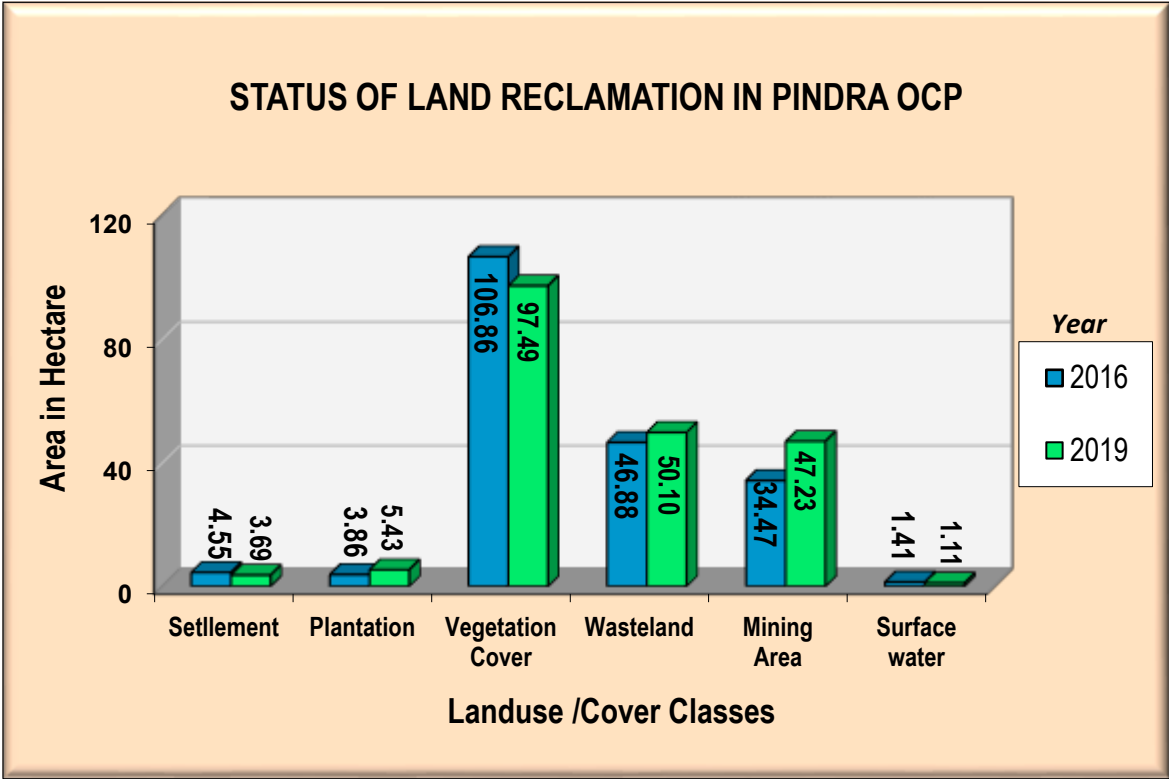


FIGURE – 7.5

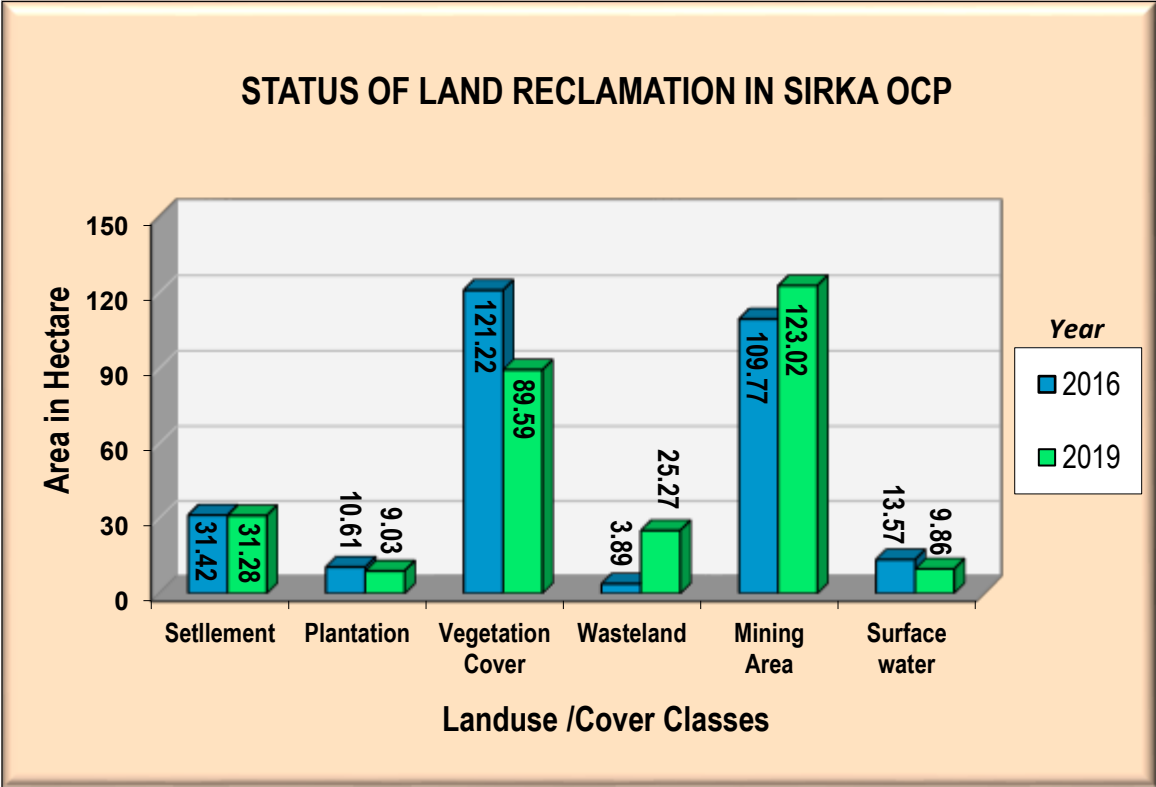


FIGURE – 7.6

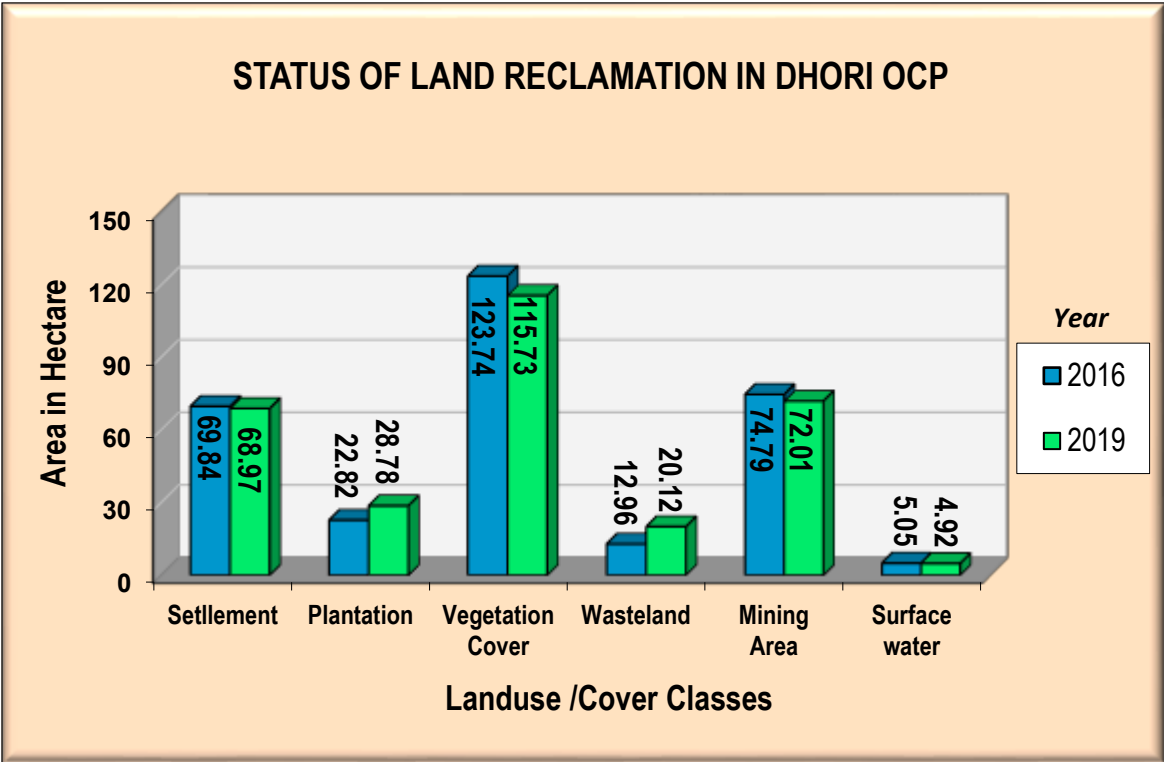


FIGURE – 7.7

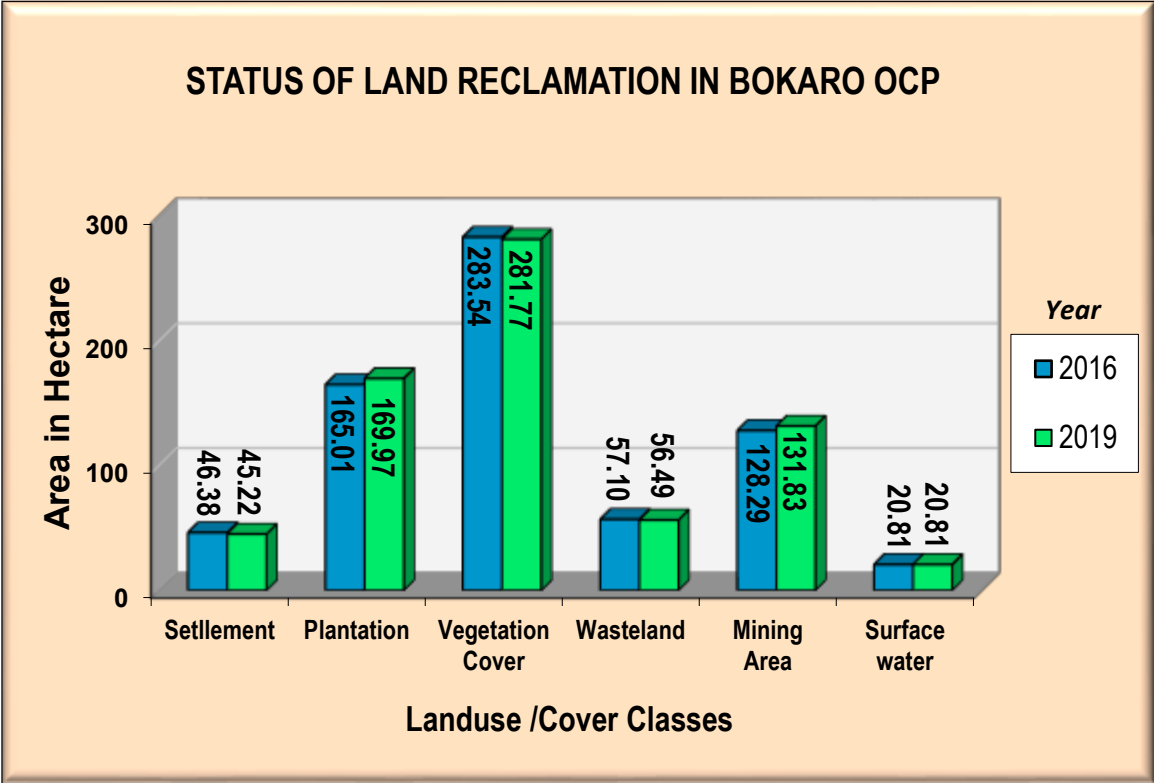


FIGURE – 7.8

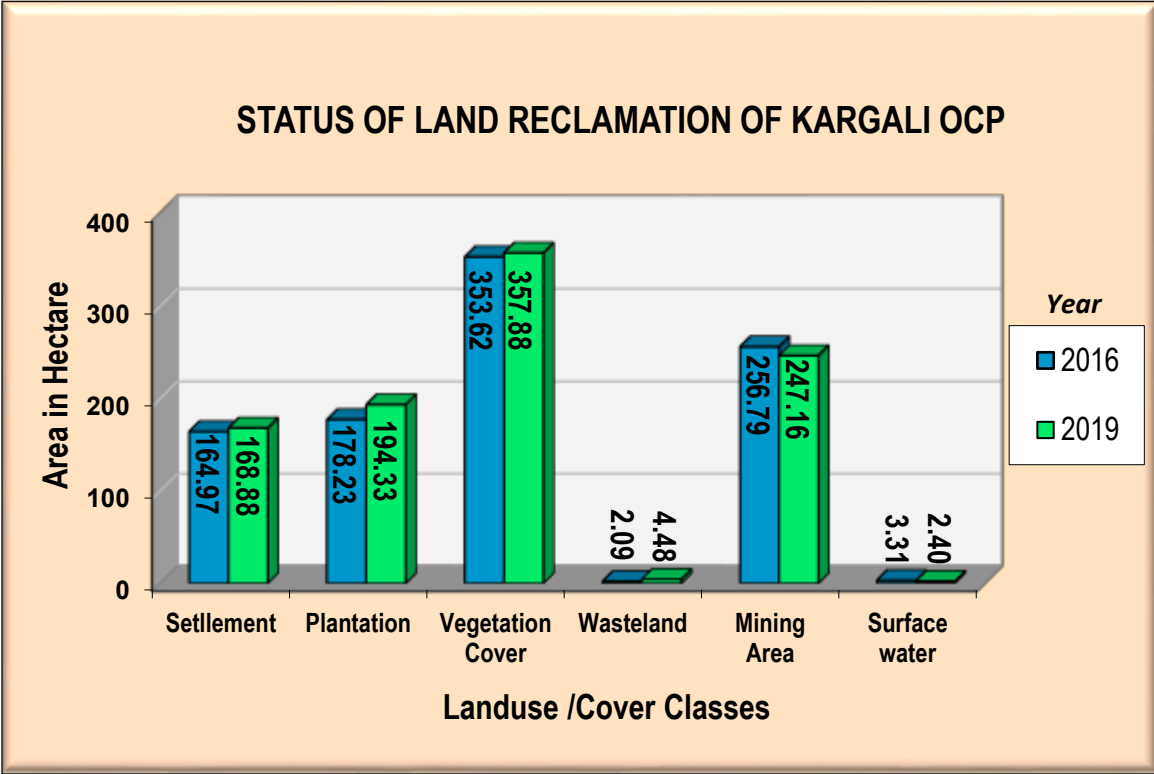


FIGURE – 7.9

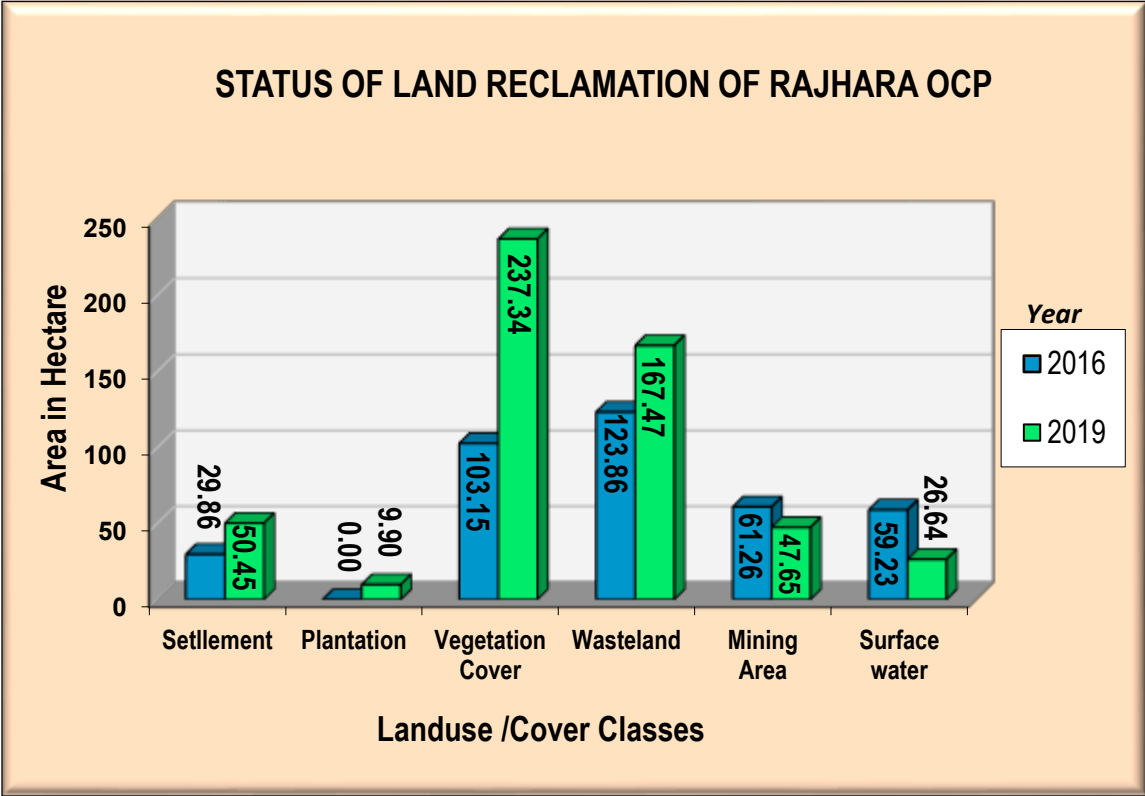


FIGURE – 7.10

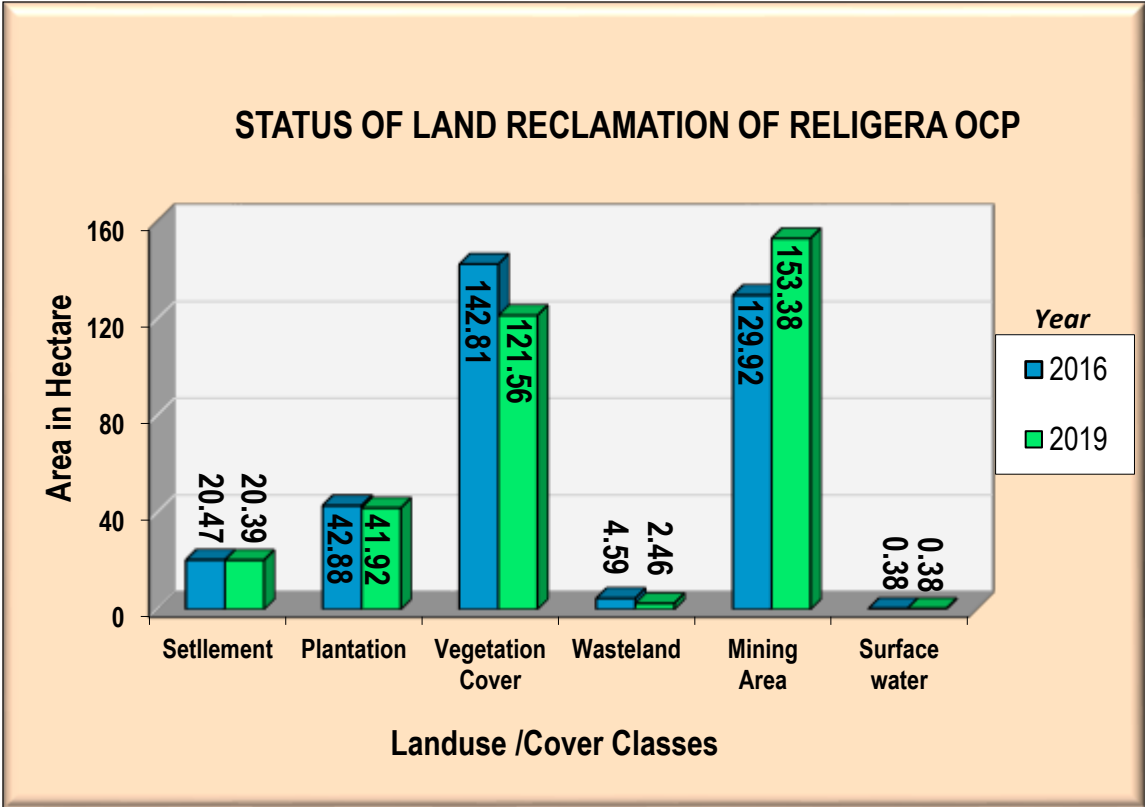


FIGURE – 7.11

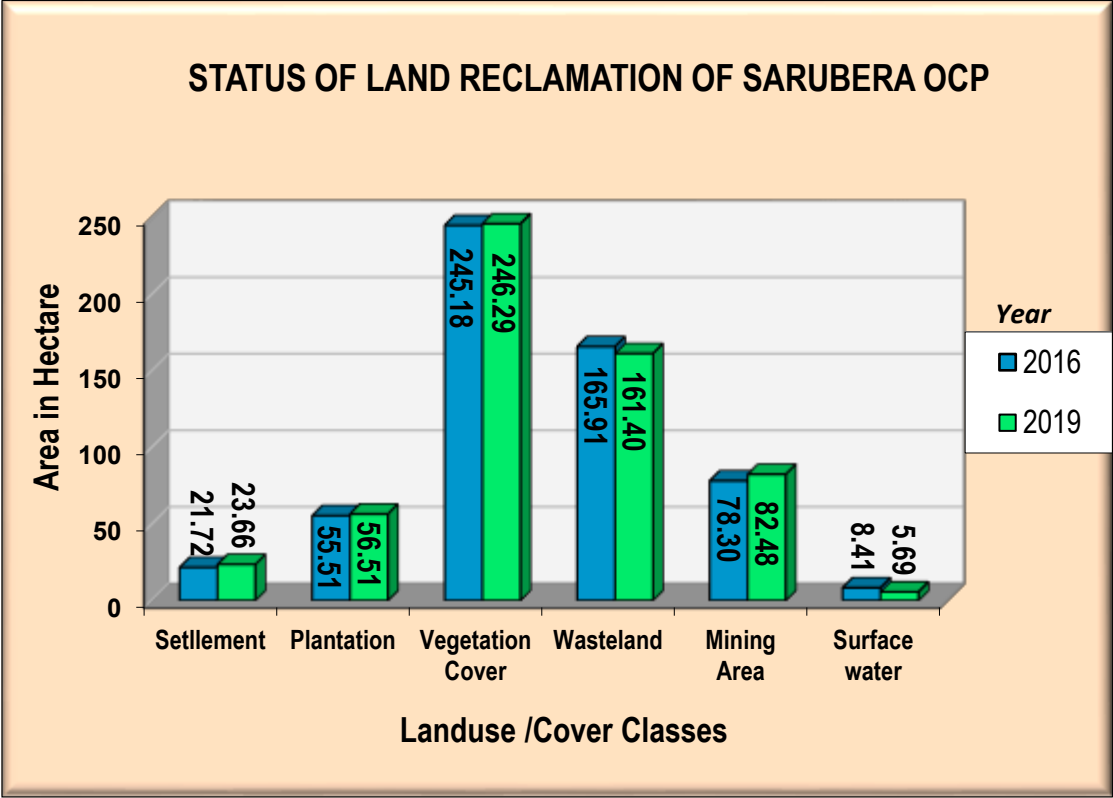


FIGURE – 7.12



Photo 7.1: Plantation on External OB Dump in Ara OCP



Photo 7.2: Bamboo plantation at ecological site in Bhurkunda OCP



Photo 7.3: Plantation on embankment in Pichri OCP



Photo 7.4: Plantation on OB Dump in Dhori OCP



Photo 7.5: Plantation on Backfill in Bokaro OCP



Photo 7.6: Plantation under Social Forestry in Religera OCP



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